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SCIENCE

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Volume 122, Number 3168

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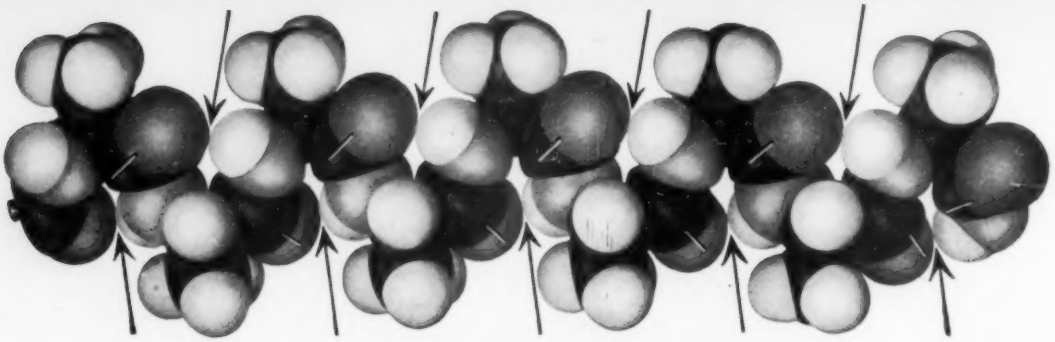
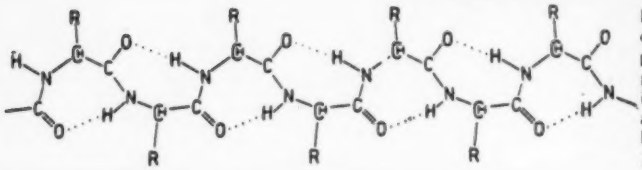
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

LARGE ATOM MODELS AID STUDY OF MOLECULAR STRUCTURE



MACRO-MOLECULES



Photograph shows how atom models are combined to construct macro-molecules. Formula is for $2_{7/5}$-folding of polypeptide chain. Side-chains are indicated by methyl groups forming an alanine chain. Note the clear periodicity. Hydrogen-bridge connections with hooks (shown by arrows) possess sufficient mobiliy for construction and hold the finished chain tightly together. Conversion to the $2_{7/5}$-folding and flapping over are easy.

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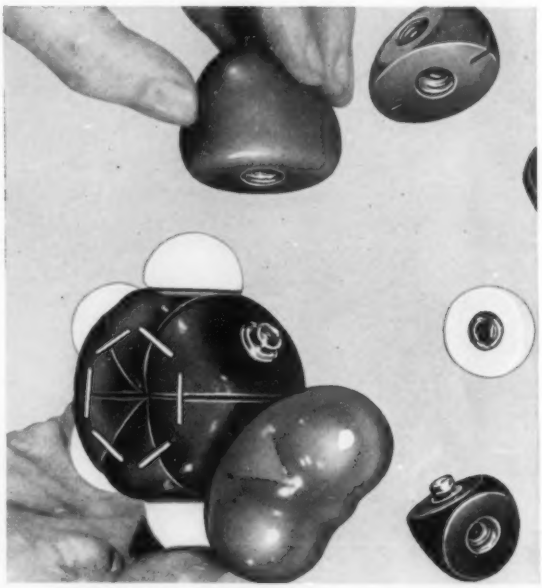

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Edited by BENJAMIN H. WILLIER, Professor of Zoology, Johns Hopkins University, Baltimore, Maryland; PAUL A. WEISS, Member, Rockefeller Institute for Medical Research, New York; and VIKTOR HAMBURGER, Professor of Zoology, Washington University, St. Louis, Missouri. 735 pages, 7" x 10", illustrated. $15.00.

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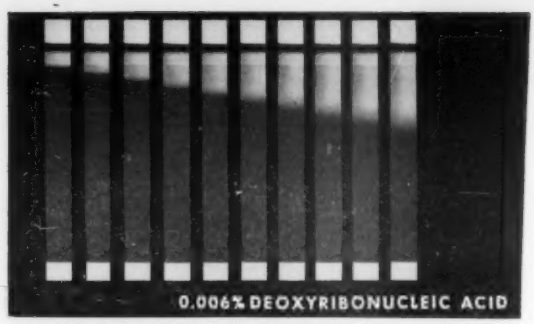

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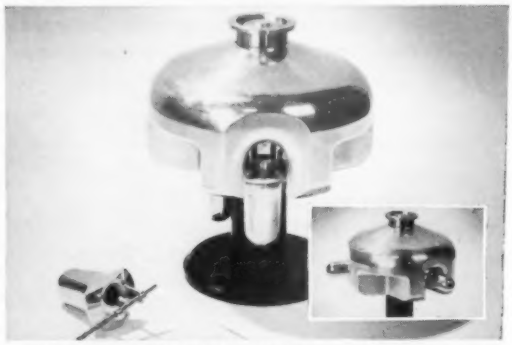

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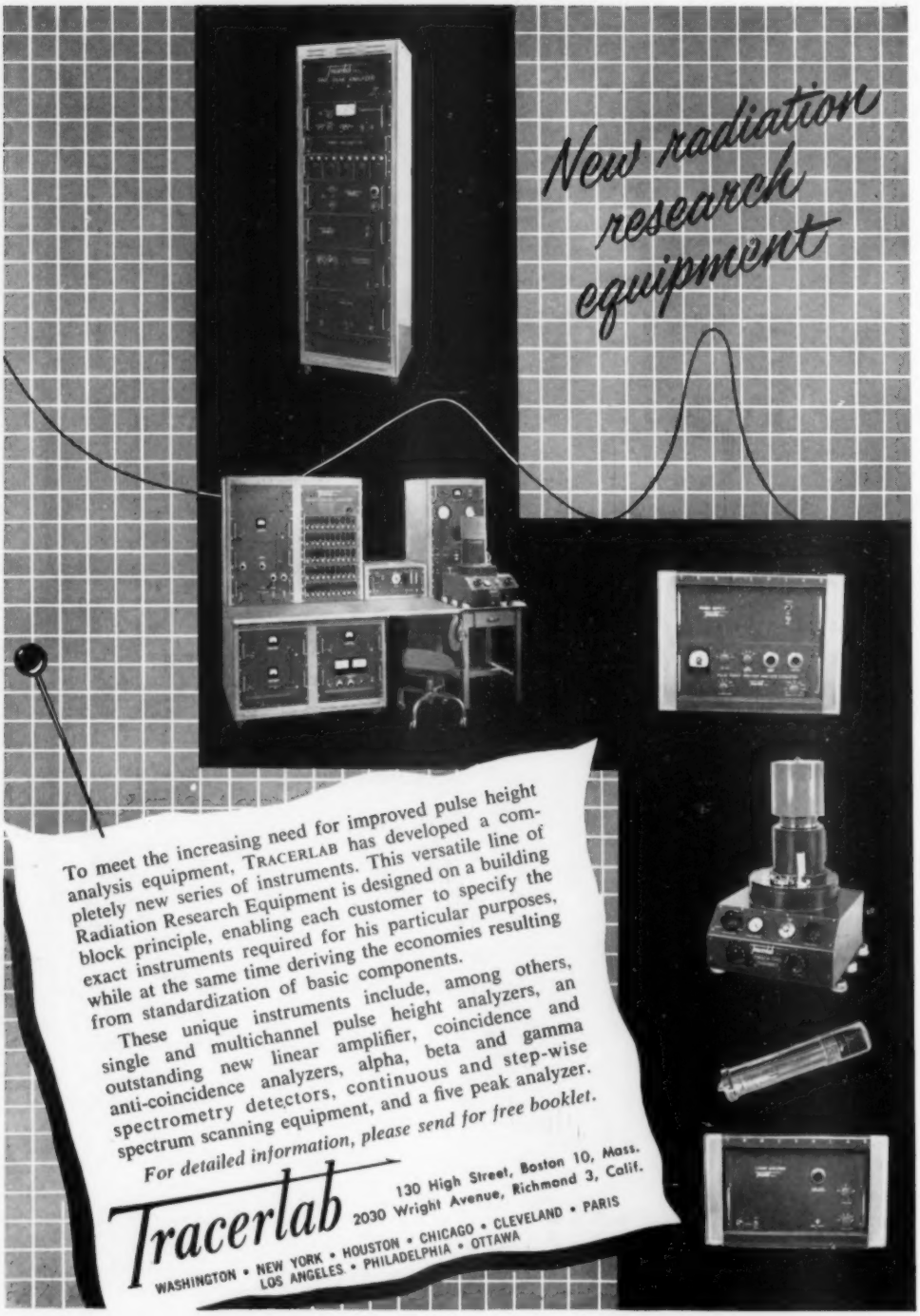
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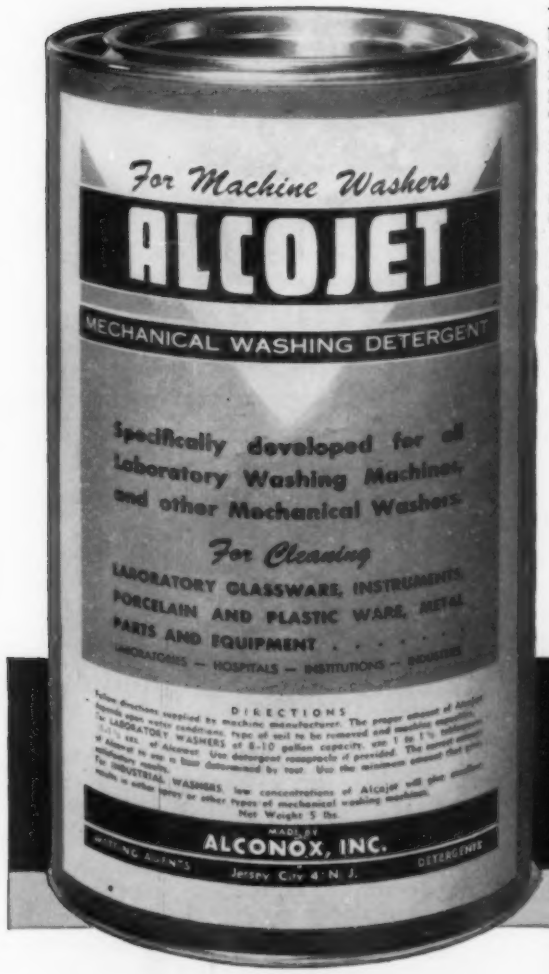
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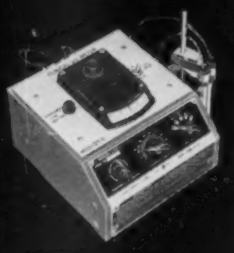

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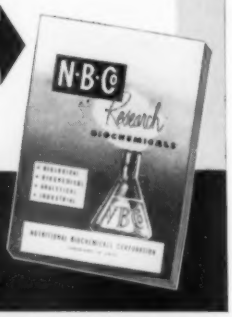

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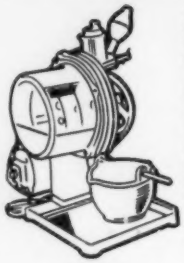

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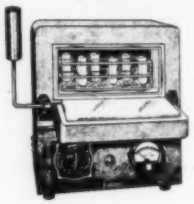

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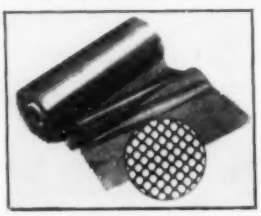

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Partners in Science Education

Countless college students have been told in the first lecture of a science course: "Forget what you learned in high school." It would be interesting to know how many of those freshmen had the wit to reply: "Who was responsible for teaching science to our high-school teachers?"

The high-school science teacher is a product of the college instruction he has had. Whether his background for the task be good or poor, he is responsible for preparing for college the students who will later enroll in college science courses. Moreover, he is responsible for giving to those of his students who will not enroll in college science courses much of the knowledge about and the attitudes toward science that they will have as adult workers, citizens, and voters. Since a large number of high-school science courses are taught by teachers whose knowledge of science is extremely weak, it is lamentably true that the advice, "Forget what you learned in high school," is frequently justified. But must not the college departments of science accept part of the responsibility for this fact?

Certainly more is required to be a good high-school teacher than mere knowledge of science, but the quality of the teacher's own knowledge is one of the most important factors—some would say the most important—in determining the quality of his teaching. Yet college departments of science have frequently shrugged off all responsibility for the training of teachers. Partly by default, the responsibility for training teachers has been assumed almost wholly by departments of education. If the science faculty does not like the result, it would seem more profitable to step in and help improve the situation than to sit back and resort to name calling.

Training future research scientists and providing a background of fundamental science for students who plan to become engineers, physicians, or members of other fields of applied science are traditional functions of the college science departments. The rise of general education has added a third function, that of teaching the student who will not work in either pure or applied science but who needs some knowledge of science as part of his general education.

A fourth function is now being increasingly recognized: the preparation of high-school teachers of science. Special courses are being offered for prospective teachers; summer session arrangements to remedy deficiencies of practicing teachers are being made; plans and courses are being prepared in cooperation with departments of education; college teachers are cooperating directly with nearby high schools in the planning of instruction and curricula. John S. Coleman, who has been keeping a close eye on such developments on behalf of the National Research Council's Division of Physical Sciences, reports that some 40 special programs have come to his attention, in all of which college science departments are going outside of their old established routines in order to do a better job of training high-school science teachers.

These developments are good. But there should be more of them. The Science Teaching Improvement Program of the AAAS, announced in *Science* a few weeks ago [**122**, 145 (1955)], has as one of its principal objectives the assumption by scientists of a larger share of responsibility for the training of science teachers. Despite a considerable measure of former aloofness, high-school and college teachers are partners in science education. There is growing recognition that fuller cooperation will enable both to improve their contributions to the total effort.—D.W.

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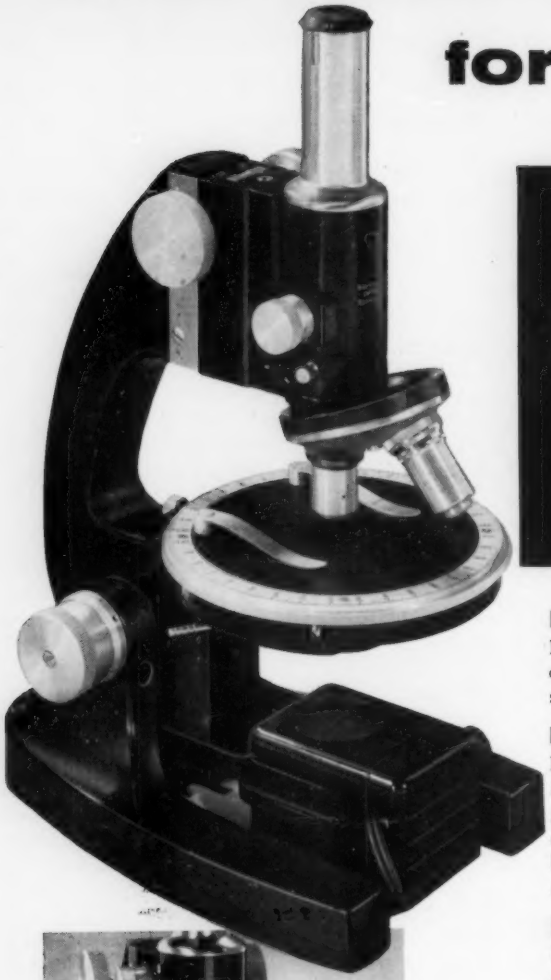

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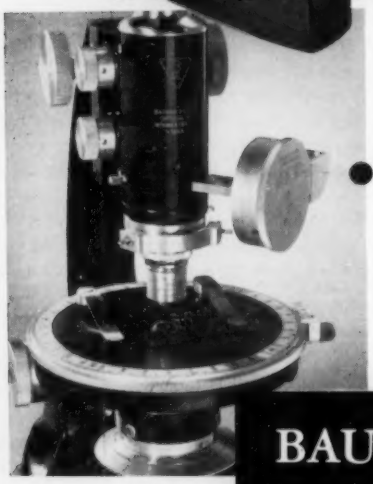

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Nutrition Needs of Mammalian Cells in Tissue Culture

Harry Eagle

Although cells grown in tissue culture are usually imbedded in a supporting structure such as a plasma or fibrinogen clot, a number of cell lines have been propagated that do not require this support but, instead, adhere to the surface of the glass container. As they multiply, they spread out horizontally on the surface of the glass to form a thin adherent sheet. Several cell lines, notably the single-cell line of mouse fibroblasts (strain L) isolated by Sanford, Earle, and Likely (*1*) and a human uterine carcinoma cell (strain HeLa) isolated by Gey (*2*), have been propagated in this manner for years. The media ordinarily employed consist of a "balanced" salt solution enriched with serum, embryonic tissue extracts, and ultrafiltrates of these materials, in varying combination. Such complex systems do not, however, lend themselves to the identification of the specific requirements for growth.

The problem was simplified with the finding (*3*, *4*) that these two cell lines could be propagated in a medium consisting of an arbitrary mixture of amino acids, vitamins, cofactors, carbohydrates, and salts, supplemented with a small amount of serum protein, the latter supplied as *dialyzed* horse or human serum. In such a system the omission of a single essential component resulted in the early death of the culture. It thus proved possible to determine most of the specific nutrients that are essential for the growth and multiplication of mammalian cells in tissue culture, to produce specific nutritional deficiencies, to study the microscopic lesions thereby produced, and to "cure" these deficiencies by the restoration of the missing component.

With the optimum medium as defined for the HeLa cell, another human carcinoma has been cultured directly onto glass (*5*), without intervening culture in a plasma clot; and a number of human cell lines cultured by other workers (*6–8*) have been propagated in the same medium for many months, with an average generation time of 40 to 60 hours. It has become possible to compare the growth requirements of normal and malignant human cells, to approach the problem of the specific metabolic requirements for the propagation of virus in such cells, and to study the incorporation of various nutrilites into cellular protein and nucleic acid. The results obtained to date are summarized in this report (*9*).

Amino Acid Requirements of a Mouse Fibroblast and of a Human Carcinoma Cell

These two cell lines proved remarkably similar with respect to their amino acid requirement. For both, 13 amino acids proved to be essential (arginine, cyst(e)ine, glutamine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, tyrosine, and valine). Only the L-amino acids were active. The D-enantiomorphs, although inactive, did not inhibit the growth-promoting action of the L-isomers. For the mouse fibroblast, the requirements for optimal growth varied from 0.005 millimolar (m*M*) in the case of L-tryptophan, to 0.1 to 0.2 millimolar for L-isoleucine (*3*), and 0.2 to 0.5 millimolar for L-glutamine (*10*). The optimal concentrations for the growth of the HeLa cell (*4*, *10*) were from 1 to 3 times those required by the mouse fibroblast.

Both cell species have been found to have active transaminating systems (*11*); and the carbon sources used for the synthesis of the six nonessential amino acids are under study.

Particular interest attaches to the glutamine requirement. The optimal requirement for growth proved to be 0.2 to 0.5 millimolar for the L cell and 1 to 2 millimolar for the HeLa cell. An unexpected finding was the fact that glutamic acid at any concentration, even supplemented by NH_4^+ and adenosinetriphosphate (ATP), failed to permit the growth of the L-fibroblast. This was not due to the impermeability of the cell, for isotopically labeled glutamic acid could be shown to be actively incorporated into protein, even from concentrations as low as 0.01 millimolar. With the HeLa cell, although glutamic acid did permit growth, approximately 10 to 20 times as much was required as of glutamine; and at the optimal level of 20 to 30m*M*, there was regularly less growth than with glutamine at 1m*M*. In this case also it is difficult to ascribe the relative inactivity of glutamic acid to the impermeability of the cell, since it was shown to be actively incorporated into protein from low concentrations. These data strongly suggest that glutamine plays an essential metabolic role which glutamic acid, NH_4^+, and ATP cannot fulfill in the case of the L cell; and with the HeLa cell glutamic acid may be active only by virtue of the fact that, at high concentrations, it can be transformed to glutamine in amounts adequate for growth (*10*).

Proline, ornithine, α-ketoglutaric acid, and asparagine, in any concentration tested, with or without NH_4^+ and ATP, failed to substitute for glutamine with either cell (*10*). Attempts to demonstrate glutamine synthetase activity, either with intact cells or with cell-free extracts, have to date been unsuccessful (*11*).

The parallelism in the relative amounts of the 13 amino acids required by the two cell lines is seen in

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Table 1. In both animal species, the concentrations present in the serum (*12, 13*), and thus available for distribution to the body fluids, were in most instances significantly in excess of those that suffice for the maximal growth of the cell line *in vitro*. However, with a few amino acids (arginine and isoleucine in the case of the mouse fibroblast; methionine, leucine, and isoleucine in the case of the HeLa cell), the requirement for optimum growth was of the same order of magnitude as the reported values for the concentration in the serum. If the requirements of these cells were the same *in vivo* as are now found after prolonged cultivation *in vitro*, then the availability of these compounds in the body fluids could have been a growth-limiting factor.

With both cell lines, a number of amino acids caused partial inhibition of growth in concentrations 2 to 5 times the maximally effective level. With both cell lines also, dipeptides were just as effective as the component amino acids in promoting growth (*14*). The degree to which these cells can use precursors of the essential amino acids is under study.

On the omission of a single amino acid from the medium, microscopic changes indicative of cell injury developed within 2 to 3 days, and the cells eventually died (Figs. 1 and 2). These changes differed significantly with the individual amino acids, perhaps reflecting their varying metabolic functions or differences in the amino acid composition and turnover rate of individual proteins. It is perhaps significant that, with many of the amino acid deficiencies, the cytopathogenic changes closely resembled those that result from viral infection.

Table 1. Amino acid requirements of a mouse fibroblast (strain L) and a human carcinoma cell (strain HeLa)

L-Amino acid	Optimum for growth of HeLa cell *in vitro*, (m*M*)	Optimum for growth of L-fibroblast *in vitro*, (m*M*)
Tryptophan	0.01	0.005
Histidine	0.02	0.01
Cystine	0.03	0.01
Tyrosine	0.03	0.02–0.05
Methionine	0.03	0.02–0.05
Phenylalanine	0.05	0.02
Arginine	0.05	0.05
Leucine	0.1	0.05
Threonine	0.1	0.05
Valine	0.1	0.05
Lysine	0.1	0.05
Isoleucine	0.1	0.1–0.2
Glutamine	1.0	0.2–0.5

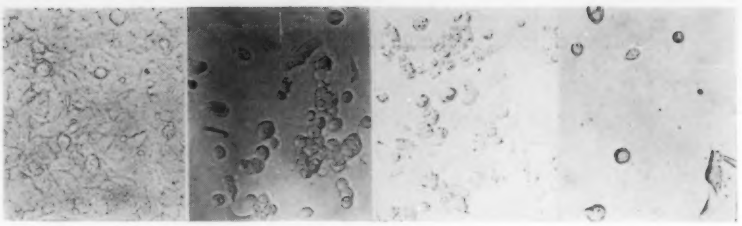

Fig. 1. Illustrative amino acid and vitamin deficiencies produced in the HeLa cell by the omission of a single nutrilite from the complete medium of Table 4. Left to right: normal control, 6 days; phenylalanine, 7 days; riboflavin, 8 days; glutamine, 5 days.

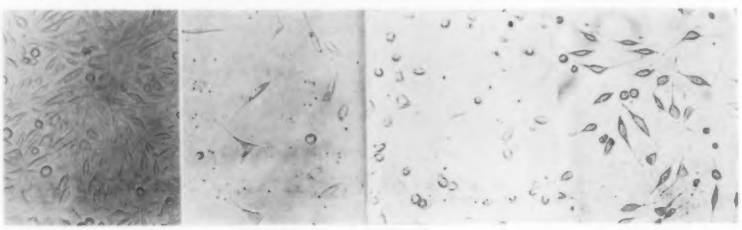

Fig. 2. Illustrative amino acid, vitamin, and salt deficiencies produced in the mouse fibroblast by the omission of a single nutrilite from the complete medium of Table 4. Left to right: normal control, 8 days; tyrosine, 9 days; choline, 4 days; Mg^{++}, 6 days.

In their early stages, the cytopathogenic effects of amino acid deficiencies were reversible. Cells that had been exposed to a medium deficient in a single amino acid and had largely degenerated in consequence could be revived on the restoration of the missing component (*3, 4*). The details of the microscopic changes produced by specific amino acid deficiencies and their reversal by the addition of the missing compound are now under study by phase and electron microscopy (*15*).

Minimum Vitamin Requirements

To date, seven vitamins have proved demonstrably essential for the growth of both the mouse fibroplast and the HeLa cell (choline, folic acid, nicotinamide, pantothenate, pyridoxal, riboflavin, and thiamine) (*16*). On the omission of any one of these from the medium, degenerative changes developed after 5 to 15 days, and the culture eventually died (Figs. 1 and 2). In their early stages, these specific vitamin deficiencies could be "cured" by the addition of the missing vitamin component to the medium. The minimum amounts of the individual vitamins and of the corresponding conjugates required for the maximal growth of the L-fibroblast are shown in Table 2. Nicotinic acid and nicotinamide proved interchangeable, as did pyridoxine, pyridoxamine, and pyridoxal; and vitamin conjugates regularly proved capable of substituting for the corresponding vitamin—for example, flavin mononucleotide (FMN) or flavin adenine dinucleotide (FAD) for riboflavin; diphosphopyridine nucleotide (DPN) or triphosphopyridine nucleotide (TPN) for nicotinamide; coenzyme-A for pantothenic acid; cocarboxylase for thiamine).

It must be emphasized that the seven vitamins so far found to be essential are not necessarily the total vitamin requirement of these two cell lines. It is possible that a number of other vitamins are essential, but probably more prolonged cultivation in an appropriately deficient medium would be necessary in order to produce the specific deficiency. Further, a number of essential vitamins may well be present as trace contaminants in the other components of the medium and would, therefore, appear to be nonessential under the conditions of the present experiments.

Salt and Glucose Requirements

The ions demonstrably essential for the survival and growth of both the mouse fibroblast and the HeLa cell were Na^+, K^+, Mg^{++}, Ca^{++}, Cl^-, and $H_2PO_4^-$ (*17*). The concentration of each ionic species required for the optimal growth of both cell lines is shown in Table 3. No information is as yet available with respect to the need for trace elements.

Both the L-fibroblast and the HeLa cell grew well in a medium containing glucose as the only carbon source over and above the essential amino acids. A

number of carbohydrates could substitute for glucose. Some (galactose, mannose, and maltose) were almost as active as glucose, mole for mole; a few were only slightly less active; and a number were weakly effective in high concentrations. The degree to which these varying activities reflect (i) the varying permeability of the cell, or (ii) the varying ability of the cell to transform them to compounds that can then enter into the normal metabolic pathways remains to be determined.

Serum Protein

A medium containing the 13 amino acids and the seven vitamins found to be essential for the growth of the L and HeLa cells, each at the optimum concentration, and appropriately supplemented with glucose did not permit growth unless a small amount of serum protein was added, conveniently supplied as dialyzed serum. For the L cell, the concentration of protein that permitted maximal growth was 1 part in 1500, and 1 part in 5000 sufficed for limited growth. Approximately 3 to 4 times these concentrations were required for the HeLa cell.

The function of the serum protein is not yet clear. It is obviously not supplying the amino acids and vitamins already shown to be essential, at least in concentrations sufficient for survival and growth. Some of the serum fractions obtained by alcohol-salt precipitation proved inert (I, II, and III), while others (IV, V) were only weakly active, separately or in combination (*9*). Exhaustively dialyzed serum was similarly inactive. On the other hand, fractions obtained by simple salting out with $(NH_4)_2SO_4$, followed by 24-hour dialysis, were all more or less equally active. The possibility that the protein contributes trace elements or vitamins that are bound to the protein but slowly dissociate in the culture medium is under study.

Applications

Chemically defined medium. The initial objective of these studies was the identification of the specific metabolites required for the growth of various cell types rather than the development of a chemically defined medium for the cultivation of mammalian cells. Obviously, however, such studies may ultimately result in the provision of a completely defined medium in which every component has been shown to be essential for the growth of a specific cell, and each component is present in the concentration optimal for that cell.

To date, as is indicated in the foregoing sections, 27 factors have been identified as essential for the growth of a mouse fibroblast and a human carcinoma cell. The factors are listed in Table 4, together with the concentrations of each used for the propagation of the two cell lines under present consideration. There remains to be determined the function of the small amounts of serum protein that must be added over and above these essential components, and in the absence of which the cells degenerate and die.

Table 2. Minimum vitamin requirements of a mouse fibroblast

Vitamin, precursor, or conjugate	Optimal concentration range (m*M*)
Choline	10^{-2}
Acetylcholine	10^{-2}
Folic acid	10^{-5}
Citrovorum factor	$10^{-6} \pm$
Nicotinamide	10^{-2}
Nicotinic acid	10^{-2}
DPN	10^{-3}
TPN	10^{-3}*
Pantothenic acid	10^{-5}
Coenzyme-A	10^{-4}
Pyridoxine	10^{-5} to 10^{-4}
Pyridoxal	10^{-5}
Pyridoxamine	10^{-4}
Pyridoxal phosphate	10^{-3}
Riboflavin	10^{-4}
Flavin mononucleotide	10^{-4}
Flavin adenine dinucleotide	10^{-5}
Thiamine	10^{-5}
Thiamine phosphate	10^{-5}*
Cocarboxylase	10^{-5}

* Significantly less growth than with vitamin.

Isolation of new cell lines in tissue culture. The striking similarity of the nutritional requirements of the HeLa cell and of the mouse fibroblast suggested that the optimum medium as so far defined for the growth of the HeLa cell might be similarly effective for other human cells. The medium of Table 4, containing the essential growth factors, all at the concentrations found optimal for the HeLa cell, and supplemented with 10-percent whole human serum was used for this purpose. A human epidermoid carcinoma of the floor of the mouth (strain KB) was cultured (*5*) by implantation of the tumor cells directly onto the glass surface, overlaid with the medium of Table 4; and initially promising results have been obtained with several other tumors.

Strain KB grows in this medium at a rapid rate, the generation time in the logarithmic phase of growth averaging 30 hours. Human liver and kidney cells cultured by Chang (*6*) and Henle (*7*), a human embryonic intestinal cell cultured by Henle (*7*), and a leukemia cell cultured by Osgood (*8*) have also been propagated in this medium, with average generation times of approximately 40 to 60 hours.

Nutritional deficiencies; antimetabolite assays. The fact that both cell types here studied degenerate and die on the omission of a single essential growth factor, whether that factor is a single vitamin, a single amino acid, or glucose, makes it possible to follow the cytopathogenic and biochemical changes that develop as a result of specific nutritional deficiencies and to follow also their reversal when the deficiency is cured by the restoration of the missing component to the medium (*15*).

It becomes possible also to determine by direct assay the growth-inhibitory activity of various antimetabolites on specific cell lines, and to determine also whether these inhibitors are competitive with normal metabolites.

The nutritional requirements for viral synthesis. With the identification of the specific metabolites required for the survival and growth of mammalian cells, it became possible to identify the components of the medium that are essential for the intracellular propagation of viruses. The amount of poliomyelitis virus released into the medium by HeLa cells was found to be quantitatively unaffected by the omission of serum protein, amino acids, or vitamins from the medium of Table 4 (*18*). In such a deficient medium the protein components of the virus are necessarily built up entirely at the expense either of the host cell protein or of its amino acid and peptide pool; and if cofactors are required for that synthesis, those already in the cell, or their precursors, suffice. On the other hand, the omission of both glucose and glutamine from the medium resulted in a marked decrease in virus production. The omission of each singly either had no effect or caused only a partial reduction.

Table 3. Minimum electrolyte requirements of a mouse fibroblast and a human carcinoma cell

Ionic species	Concn. (m*M*) permitting maximal growth* of	
	HeLa cell	L-fibroblast
Na^+	100	120
K^+	1	1
Ca^{++}		1
Mg^{++}		0.2
$H_2PO_4^-$		0.2 to 0.5

* In medium of Table 4, supplemented with dialyzed serum as there indicated.

Protein synthesis, turnover, and amino acid exchange in growing and resting cells. Given seven essential vitamins, the unidentified growth factors present in serum protein, and the necessary salts, both cell lines here studied could obtain their total requirements for energy and growth from 13 amino acids and glucose. On the omission of any one of the amino acids from the medium, the cells stopped multiplying, and the amount of cell protein then usually remained unchanged during a period of 48 to 72 hours or decreased slightly as the cells began to degenerate. There was, however, a continuing incorporation of labeled amino acids into cell protein during this entire period.

The amount of the individual amino acid incorporated was the same, whether one or six amino acids had been omitted from the medium, and in the case of L-phenylalanine approached as a limiting value approximately 35 percent of the total amount of that amino acid in the cell protein. When several labeled amino acids were used in conjunction, the amounts incorporated were additive. This incorporation of amino acids into protein from a medium in which there is no net synthesis could reflect protein turnover—that is, protein degradation and resynthesis—with total recapture of the essential amino acids that were not available from the medium. Alternatively, there may be an exchange of amino acid residues between the intact protein and the amino acid pool, similar to that described for bacteria by Gale and Folkes (*19*). These two possibilities are presently under study.

Studies are in progress on the metabolic pathways involved in the synthesis of nucleic acid and of the six nonessential amino acids from the 13 essential amino acids and glucose.

Table 4. Basal media for cultivation of the HeLa cell and mouse fibroblast (*10*)

L-Amino acids* (m*M*)			Vitamins‡ (m*M*)		Miscellaneous	
Arginine	0.1		Biotin	10^{-3}	Glucose	5m*M*§
Cystine	0.05	(0.02)†	Choline	10^{-3}	Penicillin	0.005%#
Glutamine	2.0	(1.0)‖	Folic acid	10^{-3}	Streptomycin	0.005%#
Histidine	0.05	(0.02)†	Nicotinamide	10^{-3}	Phenol red	0.0005%#
Isoleucine	0.2		Pantothenic acid	10^{-3}		
Leucine	0.2	(0.1)†	Pyridoxal	10^{-3}		
Lysine	0.2	(0.1)†	Thiamine	10^{-3}	For studies of cell nutrition	
Methionine	0.05		Riboflavin	10^{-4}	Dialyzed horse serum, 1%†	
Phenylalanine	0.1	(0.05)†			Dialyzed human serum, 5%	
Threonine	0.2	(0.1)†	**Salts§** (m*M*)			
Tryptophan	0.02	(0.01)†			For stock cultures	
Tyrosine	0.1				Whole horse serum, 5%†	
Valine	0.2	(0.1)†	NaCl	100	Whole human serum, 10%	
			KCl	5		
			$NaH_2PO_4 \cdot H_2O$	1		
			$NaHCO_3$	20		
			$CaCl_2$	1		
			$MgCl_2$	0.5		

* Conveniently stored in the refrigerator as a single stock solution containing 20 times the indicated concentration of each amino acid.
† For mouse fibroblast.
‡ Conveniently stored as a single stock solution containing 100 or 1000 times the indicated concentration of each vitamin; kept frozen.
§ Conveniently stored in the refrigerator in two stock solutions, one containing NaCl, KCl, NaH_2PO_4, $NaHCO_3$, and glucose at 10 times the indicated concentration of each, and the second containing $CaCl_2$ and $MgCl_2$ at 20 times the indicated concentration.
‖ Conveniently stored as a 100m*M* stock solution; frozen when not in use.
Conveniently stored as a single stock solution containing 100 times the indicated concentrations of penicillin, streptomycin, and phenol red.

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"Fact," as I intend the term, can only be defined ostensively. Everything that there is in the world I call a "fact." The sun is a fact; Caesar's crossing of the Rubicon was a fact; if I have toothache, my toothache is a fact. If I make a statement, my making it is a fact, and if it is true there is a further fact in virtue of which it is true, but not if it is false. The butcher says: "I'm sold out, and that's a fact"; immediately afterwards, a favored customer arrives and gets a nice piece of lamb from under the counter. So the butcher told two lies, one in saying he was sold out, and the other in saying that his being sold out was a fact. Facts are what make statements true or false. I should like to confine the word "fact" to the minimum of what must be known in order that the truth or falsehood of any statement may follow analytically from those asserting that minimum. For example, if "Brutus was a Roman" and "Cassius was a Roman" each assert a fact, I should not say that "Brutus and Cassius were Romans" asserted a new fact. We have seen that the questions whether there are negative facts and general facts raise difficulties. These niceties, however, are largely linguistic.—BERTRAND RUSSELL, *Human Knowledge*, 1948.

Efforts to Strengthen Education in the Sciences

E. P. Northrop

It is my privilege to be serving for a year and a half as consultant in education in the sciences to the National Science Foundation and, on a part-time basis, to the Fund for the Advancement of Education as well. The purpose of this article is to sketch in broad outlines the programs of this government agency and this private foundation as these programs bear on science education.

National Science Foundation

The National Science Foundation was established by Act of the Congress in 1950 as an independent agency in the executive branch of the Federal Government. In describing the functions of the Foundation, the act begins with the following charge. "The Foundation is authorized and directed to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences." (In the following discussion "the sciences" means "mathematics and the sciences.")

The most extensive activities of the Foundation, whether measured in terms of dollars expended or public awareness, are its program of grants for projects in basic research and its program of graduate fellowships. The fellowship program contributes to the support of education in the sciences in an obvious way. The announcement in March of awards to nearly 800 fellows for the academic year 1955–56 brings to a total of more than 2700 the number of man-years of graduate studies for prospective scientists that the Foundation has supported in the first 4 years of this program. Less obvious, perhaps, is the contribution to education of the Foundation's program of grants for projects in basic research. Yet hundreds of graduate students, taken into such projects as research assistants, have through such work received firsthand training and experience in basic research.

The programs of research grants and fellowships, together with certain other activities that need not concern us here, are specifically authorized and described in the National Science Foundation Act. The Congress was less explicit about what other things the Foundation might do in order to meet fully its responsibility for strengthening education in the sciences. These things the Foundation is seeking constantly to discover, with the help and advice of research scientists and teachers, professional scientific societies, and groups of educators and laymen. Proceeding with caution in an area where criteria are neither clear nor generally agreed upon, it has chosen some things, rejected some, and in the case of others has decided to suspend judgment pending further study.

The emerging program, called simply "education in the sciences," includes three categories of activities aimed, respectively, at (i) encouragement and strengthening of present high-school and college teachers of science; (ii) improvement of the science curriculum, including the training of new teachers; and (iii) increased attention to identification, motivation, and counseling of able high-school students. Let me first describe things already undertaken by the Foundation, then things in prospect.

In the first of the three categories just described—activities aimed at strengthening present teachers—the major effort of the Foundation has gone into "summer institutes" designed to help high-school and college teachers of science increase their competence—primarily their subject-matter competence. These institutes have differed from both the typical academic summer session and the typical summer workshop. In them, teachers from high schools and the smaller liberal arts colleges and universities—especially those remote from centers of research—have gathered together to learn, from persons noted for both scholarship and skill in exposition, some of the more important and recent concepts and methods of inquiry in their fields. It has been the hope that these teachers, armed with new information and insights and enthusiasms, will return to their colleagues and students and think anew with them about teaching materials, methods, and objectives in the light of modern scientific research. The enthusiasm with which this activity has been received by teachers has led the Foundation to increase the number of summer institutes it has supported from two in 1953 and four in 1954 to nine in 1955 [*Science* **121**, 414 (1955)]. Still further increases are contemplated for 1956.

The Foundation is lending support experimentally to two further activities in the same category. The first, an alternative to the summer institute, is based on the suggestion that some teachers might profit more, insofar as teaching competence is concerned, from certain summer research experiences than from summer instruction. Under a grant to one university, for example, 10 college teachers devoted several weeks in the summer of 1954 to fieldwork at a biology station. The second of these experimental activities is designed to supplement the summer institutes by sending lecturers to the teachers rather than bringing teachers to the lecturers. Specifically, the Mathematical Association of America, under a grant from the Foundation, has scheduled visits of 3 to 5 days' duration to smaller colleges and universities by several mathematicians—again, persons noted for both scholarship and skill in exposition. It has been the expectation that in the course of his visit the lecturer will be able to bring his ideas and stimulation to bear not on just one member of a given staff but on all members of the staff and on some of the students as well. The Foundation hopes in the future to enlarge this program of "visiting scientists," both by including other sciences and by extending the program to high schools.

In the category of activities aimed at improving the science curriculum are conferences of two kinds to which the Foundation has tried lending support. In conferences of a first kind, outstanding scientists and teachers have met to discuss recent developments in science with a view to determining what place, if any, they ought to occupy in the science curriculum. Conferences of the second kind, bringing together scientists, teachers at all levels, and state and local commissioners and superintendents of education, have undertaken to study and propose changes in the teaching of a particular science in one or another region of the country. The Foundation hopes in the future to increase its support of conferences of these and similar kinds.

Finally, in the category of activities aimed at increased motivation of able

Dr. Northrop is William Rainey Harper professor of Mathematics in the College, University of Chicago. This article is based on a talk given at the National Council of Teachers of Mathematics, 15 Apr. 1955, Boston, Mass.

students, the Foundation has for several years provided modest funds to enable Science Service to extend to new communities its program of science clubs, science fairs, and related activities.

The extent to which new activities can be undertaken by the Foundation in the future—and old activities expanded —depends on many factors, including availability of both adequate funds and meritorious proposals. At the risk of counting chickens not only before they are hatched but before the eggs are laid and in the nest, I should like to describe briefly a few things the Foundation thinks it should seek to do.

In the area of improvement of science curriculums there is the need for new teaching materials at both high-school and college levels. Although it has been deemed inadvisable on a number of grounds for the Foundation, a federal agency, to support the writing of this or that particular textbook as against some other, it has seemed to me that the Foundation could quite properly support the preparation of syllabuses by writing groups appointed by national associations. By "syllabuses" I have in mind not textbooks, but outlines of topics and alternative ways of presenting them, together with copious new problem material. Such syllabuses, distributed widely to teachers throughout the country, would stimulate the usual competitive writing by the teachers themselves of new and modern textbooks adapted to local needs.

Another need is for reexamination of the curriculums under which prospective science teachers are trained. Until rather recently our foremost scientists seem t have preferred to devote their full time and energy to research and to leave to others the preparation of teachers. There are now signs, however, of a growing awareness on their part that they have a responsibility here and that their contributions would be both helpful and welcome. Support of conferences at which scientists and educators can discuss this common problem will soon be in order, as will support of some of the experimental programs that will presumably emerge from such conferences.

It seems fairly certain that in spite of our best efforts to produce more and better science teachers, the supply will fall far short of the demand in the years ahead. This being the case, new and improved ways of using the teachers that will be available should be investigated while there is still time to do so with care and deliberation instead of under emergency conditions. The development and use of television and films and the training and use of teachers' aides are examples of promising leads in this respect.

In the area of identification, motivation, and counseling of able students there is much that needs to be done. Various studies concur in the estimate that of the totality of students who graduate from high school and are competent to do college work, only about half in fact enter college, and of that half only about three-fifths graduate. At the high-school level, support of such activities as the establishment of student science journals (for example, *The Mathematics Student Journal*), summer science experiences for students, and rotating science libraries might be helpful supplements to the already popular science clubs and fairs. And at both high-school and college levels new and improved counseling materials, for teachers and parents as well as for students, might be prepared. Finally, we need more knowledge than is now available about intellective and emotional factors characteristic of scientific ability, about motivation and counseling, and about career choices in science and science teaching. Support of studies designed to secure more adequate knowledge of such matters could contribute significantly to the strengthening of education in the sciences.

Fund for the Advancement of Education

The Fund for the Advancement of Education was established in 1951 by the Ford Foundation as an independent corporation, with its own board of directors. Although science teachers and teaching have, of course, received their proportionate share of attention, it must be kept in mind in what follows that the Fund seeks to serve not just science education but education generally.

Of the Fund's several major areas of concern, two are of particular interest to us here: (i) improvement of teaching, including the strengthening of present teachers, the preparation and recruitment of new teachers, and better utilization of both; and (ii) improvements in curriculums.

The Fund's fellowship programs for high-school and college teachers constitute major efforts to be of service to those who seek to improve their competence as teachers. Specifically, these programs are designed to provide recipients with a year of study and reflection, free of usual duties, in which to acquire further knowledge in their fields or in related fields, to observe at first-hand new developments in education, and to exchange ideas and experiences with colleagues in other parts of the country. Both programs are administered by national committees of educators appointed for the purpose. In the first 3 years of the high-school program, awards have been made to more than 750 teachers; in the first 4 years of the college program, to nearly 1000.

As a supplement to the fellowship programs, the Fund has supported a number of summer institutes for high-school and college teachers together. In several instances the Fund made provisions for an institute for high-school teachers in conjunction with an institute for college teachers supported by the National Science Foundation; in other instances the Fund itself supported the joint institutes. Although the aims of this program are similar in many respects to those of the Foundation's program of summer institutes, the Fund has been particularly interested in increasing communication between high-school and college teachers for the sake of improved mutual understanding and improved articulation of curriculums.

In the area of preparation of teachers, the Fund is supporting three experimental programs. One, a program of internships in college teaching, is designed to bridge the discontinuity that usually occurs in the prospective college teacher's career as he moves from full-time graduate research to full-time teaching. Under grants from the Fund to a number of colleges and universities, interns have been given the opportunity, under the supervision of experienced teachers, to observe good teaching, assume certain teaching responsibilities, and explore in seminars some of the problems of curriculum, courses, and teaching that every college teacher must inevitably meet and solve.

Two other programs of the Fund in the area of preparation of teachers are designed to alleviate the present and prospective shortage of elementary- and secondary-school teachers and to improve their quality. Both are concerned with recruitment and special training of graduates of liberal arts colleges who did not as undergraduates prepare for a teaching career, the one with recent graduates and the other with older persons such as women with lessened home responsibilities. A dozen or more experimental plans, differing widely in details but directed toward these general ends, are now being administered under grants from the Fund by colleges and universities working in close collaboration with state or local school systems.

To increase numbers of teachers is, of course, only one way of alleviating the shortage; another is to make better use of the teachers we have. For example, the Fund has made grants in support of projects that seek to explore recruitment, training, and use of teachers' aids. In one community the use of such aides to relieve experienced teachers of subprofessional duties, and so to enable them to teach many more students than

usual, has been greeted with enthusiasm by all concerned—aides, teachers, students, and parents. The fact that the experience has stimulated a number of the aides to undertake professional teacher training has obvious implications for recruitment of regular teachers. The Fund has also supported some experimental efforts to develop and use closed-circuit television and kinescopes, so that outstanding instruction can be brought to many times the number of students who now benefit from it. Still other means to better utilization of teachers should be explored more fully: the use of older students as tutors, the encouragement of more and earlier independent study, and the adoption of simpler curriculums.

In the area of curricular improvement, the Fund has directed its attention primarily to the work of the secondary-school and college years with a view to enabling the student—especially the abler student—to move through these years at a rate commensurate with his ability and maturity and to provide him with the best possible education along the way. Three major projects supported by the Fund have these ends in common but are distinguishable in the means they use to approach these ends.

In one of these projects three preparatory schools and three colleges attended by many graduates of the three schools undertook a joint study of their respective programs. Conceiving of the last 2 years of secondary school and the first 2 years of college as an integrated whole, the joint committee found the current educational pattern wasteful of student time and interest. In recommending a new pattern the committee was led to the conclusion that better students should be able to complete the traditional 8 years in 7, either by going directly from 11th grade to freshman year or directly from 12th grade to sophomore year.

Acceleration by entrance to college before graduation from school characterizes a second of the three projects. In this project a dozen colleges have been exploring the desirability of admitting students under 17 years of age who appear to be ready in terms of intellectual and personal growth to undertake regular college work.

In contrast, acceleration by admission to college with advanced standing characterizes the third project. As a result of joint exploratory studies by certain secondary-school and college teachers and adminstrators, a dozen colleges have agreed to consider for advanced credit those graduates of some 40 schools who in their final school years have completed especially designed college-level courses.

These attempts to reduce the number of years spent in formal education by able students have important implications for science. If, for example, ways could be found by which science-bound students could complete requirements for the Ph.D. degree a year earlier than they now do, and without sacrifice of quality of training, consider what the year so saved might mean in terms of the nation's total scientific output. Of particular significance is the fact that the extra year made available for independent research would come at the beginning of what for most scientists is their period of maximum productivity.

Concluding Remarks

It should be clear from what has been said that in both the Foundation's program of education in the sciences and the Fund's program at large, top priority has been assigned to teachers: to the strengthening of present ones, the preparation of new ones, and the better utilization of both. This policy can be justified, it seems to me, on several grounds.

We are being told with increasing frequency and forcefulness that, in order to safeguard both the national security and the national economy, it is imperative that we increase the supply and improve the quality of scientists and engineers.

Consider first the question of supply. In my more optimistic moments I like to think that the problems of numbers of scientists and engineers may be met in a natural fashion by the fact that both the population as a whole and the percentage of college-age youngsters who go to college are increasing. In any case, it is hard enough to estimate what today's demands for scientific and engineering manpower are and many times harder to estimate what the demands 15 or 20 years hence will be.

By contrast, estimating future needs for teachers seems simple and safe. Although the ideas and techniques that will be of first importance to the nation 15 or 20 years from now may not yet be born, the children of the nation have been born. We know how many there are and where they will be in school or college during the next 15 or 20 years, and we can compute with fair accuracy the numbers of teachers that will be needed to teach them under this or that assumption concerning optimal class size. We are faced on the one hand with a swelling population of school and college students and on the other with a shrinking population of college graduates prepared to teach. The shortage promises to be especially acute in the case of teachers of science and mathematics, where competition from industry for college graduates trained in these fields is most heavily felt.

Consider next the question of quality. Just as a shortage of teachers can be alleviated in part by making better use of those we have, so a shortage of scientific and engineering manpower can be alleviated in part by increasing the quality of the scientists and engineers we have. Moreover, whereas some doubt our ability to make use of greatly increased numbers of scientists and engineers in the future, few if any would express similar doubts concerning improved quality. Here the role of the teacher is of undisputed importance. For in the last analysis it is the teacher who constructs the curriculum. And it is the teacher who instructs and inspires the students destined to become the scientists and teachers of the future.

Surely, such considerations as these warrant the increasing attention now being accorded to teachers and teaching by government agencies, private foundations, industrial concerns, and the public at large in support of efforts to strengthen education in the sciences.

The science teacher should always teach that science has made two fundamental contributions to modern life: it has given man the choice between want and abundance; and it has freed him from irrational fear. Man has not quite conquered fear, but through science he has freed himself from the tyranny of ancient superstition and is gradually coming to understand his own inner fears. The scientific conception of the nature of the world and of man can free man's mind just as the scientific control of matter and energy has freed his hands.—ROBERT J. HAVIGHURST, *Sch. Sci. and Math.* **44**, 120 (1944).

News of Science

National Merit Scholarship Program

Formation of the National Merit Scholarship Corporation, Evanston, Ill., was announced on 6 Sept. by its president, John M. Stalnaker. The corporation is an independent, nonprofit organization whose purpose is to devise and administer a nation-wide system of scholarships for higher education. The Ford Foundation and the Carnegie Corporation of New York have undertaken to finance the activity by providing grants totaling $2.5 million for its administrative expenses. The Ford Foundation has also appropriated a $10-million scholarship fund, payable at the rate of $1 million a year for 10 years, and is prepared to finance additional scholarships up to a total of $8 million. All secondary schools, public and private, are entitled to participate in the program.

The major underlying purposes of these grants are twofold: to find this country's most talented young people and make a college education available to them regardless of their financial situation; and to make it easy for business enterprises to contribute effectively to the support of higher education. A further purpose is to provide, in one organization, a single program that will reduce wasteful duplication of operation and expense and will, at the same time, protect fully the natural interests and purposes of the donors. The flexibility of the present program provides this protection.

In addition to Stalnaker, the members of the corporation's board of directors are Laird Bell, *chairman*, of Bell, Boyd, Marshall and Lloyd, Chicago; Walker Lee Cisler, president, Detroit Edison Co.; Ward Darley, president, University of Colorado; John S. Dickey, president, Dartmouth College; J. W. Edwards, superintendent of schools, Portland, Ore.; Henry T. Heald, chancellor, New York University; Dexter M. Keezer, vice president, McGraw-Hill Publishing Co., New York; Nancy D. Lewis, dean, Pembroke College; I. Newman, president, Maison Blanche Co., New Orleans, La.; Hollis F. Price, president, LeMoyne College; Sidney J. Weinberg, partner, Goldman Sachs and Co., New York; and Robert E. Wilson, chairman of the board, Standard Oil Co. (Ind.), Chicago.

All scholarship selections will be made on the basis of merit, but the stipend will be based on need. The minimum stipend will be $100 a year; the maximum will cover the full cost of attending the institution selected; in every case a "cost of education" grant will be made to the college.

The interest and cooperation of corporations concerned with the higher education of exceptional students is invited. The National Merit Scholarship Corporation has $8 million with which to match contributions received from corporations or from other donors. These funds, not otherwise available, would serve to double the effectiveness of the donor's contribution. Scholarships financed by these matching funds will be known as National Merit Scholarships. The program provides the following advantages to corporations.

1) All the mechanism and operation of a nationwide selective program will be undertaken, carried out, and paid for by the National Merit Scholarship Corporation, which will also administer the scholarship throughout its duration at no cost to the donor.

2) Donor-identity with all scholarships is completely maintained at all times, each such scholarship bearing the donor designation.

3) Donors may specify criteria for their scholars, such as geographic origin or location, career-purpose, type of education desired, identity or regional location of student's first-choice college, sex of students, parents' occupation, and so forth. Participation is limited to American citizens. Because the race and religion of participants will not be considered in making selections, information on these items will not be obtained. The scholarship corporation or the donor will select, from the winners of the competition, students conforming as nearly as possible to the donor's requirements.

4) Donors may provide any desired number of scholarships, on a 4-year basis, at the average cost of all scholarships, including grants to institutions. They may pay either in a lump sum or year by year. Costs will be readjusted at the end of each year.

5) It is estimated that the average cost of a 4-year college scholarship is $6000; as a rule, of this amount $2500 will be given to the college selected, the tuition will cost an additional $2500, and $1000 will be required for other student expenses.

With the announcement of the National Merit Scholarship Corporation, both the Sears-Roebuck Foundation and Time, Inc., revealed plans to participate in the program. Sears will provide $600,000 for the support of 100 4-year scholarships in 1956. Each year thereafter it is expected that Sears will award 100 more Sears Foundation merit scholarships. Time, Inc., has allocated $30,000 to support five Time-Life scholarships. The Time grant was actually made in 1953 when plans for establishing the scholarship corporation were still in the formative stage.

Beginning this fall, the more than 24,000 secondary schools of the nation will be invited to participate annually in the National Merit Scholarship Program by selecting the outstanding 5 percent of their senior classes as available candidates. All such entrants will be given a screening test; the highest scorers in each state, to the extent of 10 times the number of scholarships available for that state, will be given the scholastic aptitude test of the College Entrance Examination Board. The highest scorers in this test, for each state, to the extent of 5 times the number of scholarships to be awarded, will be requested to supply further information with regard to school records, recommendations, and biographical information. Using all of this background material, the selection of the winners will be made.

To enter a school in the program, the principal *must return the entry form by 14 Oct.* to National Merit Scholarship Program, Educational Testing Service, 20 Nassau St., Princeton, N. J. The preliminary aptitude test is to be given on 26 Oct. The Merit Program, as now financed, is the largest independent scholarship program in the history of American education.

News Briefs

■ Tests of the effect of primary cosmic radiation on animals have been made in connection with Air Research and Development Command research projects that are being conducted in the Space Biology Branch of the Aero-Medical Field Laboratory at Holloman Air Development Center, N.M. Living animals were exposed to cosmic radiation during

a series of balloon flights from Sault Ste Marie, Mich., in the summer of 1954. The baloons used were of a plastic type that is capable of maintaining altitudes higher than 90,000 feet for a minimum of 28 hours.

Monkeys were sent aloft to test the effects of cosmic radiation on the central nervous system. Investigators who observed the animals for a period of 6 months after the flights were not able to detect any adverse effects on the animals' behavior. Albino mice were exposed to test radiation effects on eyes. No cataracts were observed in the eyes of the mice after exposure.

None of the specimens, except black rats, lost hair or suffered permanent injuries from exposure to primary cosmic radiation. The black rats incurred some damage to hair follicle pigment cells—the affected cells produced white hair.

■ Blueprints of Japan's experimental rockets were stolen from a car in downtown Tokyo on 28 Aug. Hideo Itokawa, a professor and head of Japan's rocket research, said the plans were for baby rockets that were tested in mid-August as well as for supersonic two-stage models that are to be fired this fall.

■ The Sabbatsberg Hospital in Stockholm, Sweden, is starting an artery bank, according to a report from the United Nations Educational, Scientific, and Cultural Organization. Swedish scientists have stated that methods of preserving arteries have been perfected that permit storage for long periods.

■ The House of Representatives approved appropriations totaling $89,138,000 for the National Institutes of Health for the coming year. This is the full amount of the budget request and $7,870,000 more than was voted last year. Almost half of the increase is for the National Institute of Mental Health.

■ The rare, diminutive key deer—named for the Florida Keys they inhabit—number 94, according to a census taken by the U.S. Fish and Wildlife Service. Frequent counts are made in an effort to save these tiny mammals from extinction.

Smallest of all American deer species, the average adult key deer is 27 inches tall, 38 inches long, and weighs 30 pounds. The young are no bigger than cottontail rabbits.

■ A Cançer Chemotherapy National Committee has been established; it is headed by Sidney Farber of Boston. The committee will give guidance to a national voluntary program of cooperative research and development to find and produce effective drugs for the treatment of cancer. Kenneth M. Endicott of the National Cancer Institute is executive secretary of the committee and is in charge of the full-time staff. Headquarters will be located at the Cancer Chemotherapy National Service Center, in Bethesda, Md.

■ A new type of vaccine to prevent Newcastle disease in chickens has been developed at the Michigan State University Experiment Station. Walter N. Mack, microbiologist, reports that he has modified the Newcastle virus with a drug in order to make a noninfectious vaccine.

It is reported that the vaccine will not produce Newcastle disease and that other viruses that may be in the egg material from which the vaccine is made are rendered harmless by the chemical treatment. The treatment destroys the disease-producing ability of the virus but does not harm its ability to produce antibodies in the chicken.

■ Plans have been announced for the immediate construction of a national headquarters building for the Association of American Medical Colleges in Evanston, Ill. The building is to be located at Ridge Ave. and Central St., 2 blocks west of Northwestern University on a site made available by the university. Gifts from the China Medical Board of New York and the Alfred P. Sloan Foundation made the building possible.

Founded in 1876 and reorganized in 1890, the association represents 81 United States medical colleges and 12 in Canada, Puerto Rico, and the Philippines. Present headquarters are at 185 N. Wabash Ave., Chicago.

Scientists in the News

WILLIAM H. MARTIN, a retired vice president of Bell Telephone Laboratories who has been serving as Deputy Assistant Secretary of Defense for applications engineering, has been appointed director of research and development for the Army. In his new capacity, Martin will exercise the same degree of responsibility as an Assistant Secretary and will be given complete authority over Army research programs.

Creation of this research post is the result of some criticisms by the Hoover Commission on Organization of the Executive Branch of the Government [*Science* **121**, 847 (17 June 1955)]. The commission pointed out that some research functions suffered because of overlapping activities. Improved Army organization is expected from the new appointment.

LEOPOLD INFELD, theoretical physicist and a professor at the University of Warsaw, has been appointed by the Polish Academy of Sciences to head a committee that will plan and coordinate Poland's research in the peaceful uses of atomic energy. The committee is composed of 30 specialists in physics, chemistry, biology, and technology.

The academy has also established a Nuclear Research Institute under the direction of ANDRZEJ SOLTAN. Soltan's recent work has been concerned with methods for detecting the presence of uranium and thorium in certain minerals.

JACOB VERDUIN, who until recently was associate professor of the Franz Theodore Stone Institute of Hydrobiology (now the Francis Theodore Stone Laboratory), which is sponsored by Ohio State University at Put-in-Bay, Ohio, has been appointed associate professor of biology at Bowling Green State University. At Stone he was a member of the permanent staff that carried on a continuous program of research on problems concerning the productivity of Lake Erie.

The appointment of Verduin, who will teach courses in botany and general biology, will fill the staff vacancy caused by the death this summer of WALDO E. STEIDTMANN, chairman of the biology department. CHARLES H. OTIS, a member of the department since 1930 and former chairman, was recently named acting department head for the 1955–56 academic year.

LAWRENCE R. HAFSTAD has been appointed head of the research staff of the General Motors Corp., effective later this year. He will succeed CHARLES L. MCCUEN, general manager of the research laboratories division since 1947, who is to retire after 29 years of service. By agreement with the Chase Manhattan Bank, Hafstad will be available to the bank in a consultative capacity on atomic energy matters "where there is no conflict of interest."

GORDON GUNTER, director of the University of Texas Institute of Marine Science, Port Aransas, was appointed director of the Gulf Coast Research Laboratory at Ocean Springs, Miss., on 1 Sept.

FRANCES A. HELLEBRANDT retired on 1 Sept. as head of the department of physical medicine and rehabilitation at the University of Illinois College of Medicine. She will live in Athens, Ohio, where she will devote full time to historical research and scientific writing.

A teacher and investigator in medical

schools for 25 years, Hellebrandt joined the University of Illinois in 1951 as a department head. She had previously directed the Baruch Center of Physical Medicine at the Medical College of Virginia, and before that she was head of the section on physical medicine and associate professor of physiology at the University of Wisconsin. She organized the physical therapy schools in both institutions. DAVID I. ABRAMSON, a member of the university's department of medicine staff since 1946, will succeed Hellebrandt.

DAVID C. MCCLELLAND of Wesleyan University will become professor of psychology at Harvard University on 1 July 1956. McClelland, who is an authority on motivation, will fill a new chair in the psychology of personality that was endowed by the Ford Foundation with a grant of $400,000. He will conduct his research in the Laboratory of Social Relations.

BERNARD BUDIANSKY, an engineer whose research has been concerned with vibrations and stresses in aircraft structures, has been appointed associate professor of structural mechanics at Harvard University. Since 1952 he has been head of the structural mechanics branch of the Structures Research Division, Langley Aeronautical Laboratory, National Advisory Committee for Aeronautics, Langley Field, Va.

JOHN C. CALHOUN, JR., professor and head of the department of petroleum and natural-gas engineering at Pennsylvania State University, became dean of engineering at the Agricultural and Mechanical College of Texas on 1 Sept.

SUSHIL KUMAR PRAMANIK, who retired as deputy director of the Indian Meteorological Service last year, arrived in Teheran, Iran, on 26 Aug. to fill a 6-month assignment as a consultant for the World Meteorological Organization and the United Nations Technical Assistance Administration. He will assist the Government of Iran in coordinating various meteorological services; this will lead to the establishment of a National Meteorological Institute in Iran.

WILLIAM J. RIEMER, formerly of the University of California, Berkeley, and WILLIAM H. SEARS, formerly of Hofstra College, Hempstead, N.Y., have joined the staff of the Florida State Museum, Gainesville, as, respectively, assistant curator of biological sciences and assistant curator of social sciences. Sears is working with the museum's archeological and anthropological collections. Both appointments were effective in July.

RUSSELL L. MAYCOCK, former assistant manager of the physical chemistry department at the Shell Development Co.'s Emeryville research center, has been appointed director of the company's research laboratory in Houston, Tex. He replaces J. ANDERSON, who has been transferred to Torrence, Calif., to direct research for the Shell synthetic rubber plant there.

ARTHUR BEVAN, principal geologist of the Illinois State Geological Survey since 1947, has retired in order to resume field studies in the Appalachian Mountains of west-central Virginia. Before he joined the Illinois Survey he had been state geologist of Virginia for 18 years. He will reside in Churchville, Va.

The following appointments to assistant professor have been announced. University of Mississippi: LOUIS F. RITTELMEYER, JR., preventive medicine. Rose Polytechnic Institute: FRANK A. GUTHRIE, chemistry. Albany Medical College: WILLIAM THOMAS SMYTH, pathology and bacteriology.

Necrology

DAVID CRAMPTON, Mantoloking, N.J., 45, chief chemical engineer for Wallace and Tiernan, Belleville, N.J., and president and chairman of the board of Stewart Industries, Inc., Clifton, 28 Aug.

CHARLES A. EMERSON, East Orange, N.J., 73, sanitary engineer, former chief engineer for the Pennsylvania State Health Department, and a partner in Havens and Emerson, New York, 24 Aug.

THURMAN D. KITCHIN, Wake Forest, N.C., 69, president emeritus of Wake Forest College, former dean of Wake Forest Medical School, 28 Aug.

HOWARD SHIELD MCCANDLISH, Washington, D.C., 64, emeritus associate professor of clinical obstetrics and gynecology at Cornell University Medical College, 26 Aug.

EDWIN N. ROSENFELD, North Hollywood, Calif., 63, chemist and former assistant inventor to Thomas A. Edison, 27 Aug.

EDWARD B. SILVERMAN, New York, 60, electrical engineer for Smith and Silverman, New York, 29 Aug.

ANDREW TOPPING, London, England, 64, dean of the London School of Hygiene and Tropical Medicine; former UNRRA deputy chief, 28 Aug.

JAMES WALTON, London, England, 73, former professor of surgery at London Hospital Medical School, former president of the Association of Surgeons, Medical Society of London, and the Surgical Section of the Royal Society of Medicine, 27 Aug.

ARTHUR MANLEY WICKWIRE, JR., Morristown, N.J., 57, engineer and inventor, president of Power Controls, Inc., Yonkers, N.Y., 27 Aug.

Education

■ Columbia University's School of Engineering has planned a program that is designed to encourage industrial scientists and engineers to return to the campus to become acquainted with recent electronics developments. The university has scheduled a series of evening courses in electric circuits and electronics that is intended for technical men with a bachelor's degree in engineering or science. These courses are offered because entire areas of activity have developed that require scientific and mathematical tools that were not part of the education of electrical engineers trained before World War II.

■ The Special Training Division of the Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn., has announced a partial schedule of courses to be offered during the next 12 months. The institute, a nonprofit educational corporation formed by 32 Southern universities, conducts 4-week courses in the basic techniques of using radioisotopes in general research, and special and advanced courses of varying duration that stress applications of radioisotopes in specific fields of scientific endeavor.

The 47th through the 53rd basic courses, which are limited to 32 participants, will be held on the following dates: 17 Oct.–11 Nov. 1955, 9 Jan.–3 Feb. 1956, 6 Feb.–2 Mar., 16 Apr.–11 May, 4–29 June, 16 July–10 Aug., and 13 Aug.–7 Sept.

The institute's basic courses are designed to assist mature scientific and technical personnel in obtaining in a short time sufficient facility in the use of radioisotopes to utilize them safely and efficiently in their own research. Minimum scholastic requirement for enrollment is a bachelor's degree, preferably in a scientific field, but no specific courses are required as prerequisites.

Tuition for the basic course is $25.00. Application blanks and further information may be obtained by writing Dr. Ralph T. Overman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn. Applications and supporting letters should be in the hands of the Institute 3 months in advance of the starting date of the course for which application is made.

Veterinary Radiological Health Courses. In September 1954 the institute initiated the first 2-week advanced

course in veterinary radiological health to be offered in this country specifically to meet the needs of veterinarians in the armed forces. These courses, which are presented in cooperation with the University of Tennessee–Atomic Energy Commission Agricultural Research Program, are designed to instruct military veterinary officers in the evaluation of problems of radiation phenomena, particularly in relation to their biological effects and the possible or potential factors involved in the radiocontamination of food-producing animals and animal-food products. Starting dates for future veterinary courses are 12 Sept., 26 Sept., 10 Oct., 24 Oct., 7 Nov., 12 Mar. 1956, 9 Apr., 23 Apr., and 7 May.

■ The new seven-story Morton medical research building of Northwestern University, Chicago, will be dedicated on 27 Sept. during the 98th Founders Day ceremonies commemorating the founding of the medical school. Sterling Morton, chairman of the board of the Morton Salt Co., will speak at the dedication. His mother left a $2 million bequest in memory of her husband for construction of the building.

The new unit is connected to the Montgomery Ward memorial building, which houses the medical and dental schools. Designed to permit maximum flexibility for any size or type of research, the Morton structure's features include movable metal wall partitions equipped with water, gas, steam, air, and vacuum pipes. The partitions, which can be set up at any 10-foot interval within the building, will allow speedy conversion of laboratories to almost any size desired. Laboratories are being installed so that preclinical research in the Ward building and clinical research in the Morton building can be physically correlated with maximum efficiency.

■ For the first time the University of Detroit McNichols evening division is offering a complete 9-year curriculum leading to a degree in mechanical engineering. The first 4 years of the new program is equivalent to the curriculum offered in the first 2 years of the College of Engineering day program. It is equivalent also to the first 4 years of work, designated preengineering, offered up to the present in the McNichols evening division.

■ The School of Dental Medicine at Tufts University, Boston, has announced a series of new courses to be conducted in Spanish for foreign dentists. The courses will be open to Spanish-speaking dentists who are graduates of dental schools that have been accredited in their respective countries.

Grants, Fellowships, and Awards

■ For the eighth consecutive year the National Paraplegia Foundation is awarding fellowships to be used for research in basic and medical sciences bearing on the problems of paraplegia. The fellowships are open to residents of the United States or Canada who have demonstrated ability in research. Fellows are expected to devote full time to research during tenure of the fellowship, except that by permission of the Medical Advisory Committee they may attend advanced courses of study that require only a limited portion of their time.

Preference is given to candidates whose primary interest is in the field of spinal cord function and disease, or in complications arising from spinal cord injury. Appointments run for 1, 2, or 3 years; they are subject to renewal for additional periods. The stipends range from $3000 to $4000 yearly, depending upon the past record of the applicant in scientific work, his family obligations, and the cost of living in the location chosen for study. In exceptional cases grants may be as high as $6000. For information address the foundation at 1040 W. Michigan St., Indianapolis 7, Ind.

■ The Division of Medical Sciences of the National Academy of Sciences–National Research Council is accepting applications for postdoctoral research fellowships for 1956–57. These awards are designed to offer research experience for promising individuals who look forward to investigative careers, and not to provide practical experience in the clinical field. Ordinarily fellowships are not granted to persons over 35 years of age. The following programs are announced:

Fellowships in Cancer Research are awarded by the American Cancer Society on recommendation of the division's Committee on Growth. Awards are available for study in all branches of the biological, chemical, and physical sciences, and for clinical investigation applicable to the study of growth, typical or malignant. Citizens of the United States are eligible.

British-American Exchange Fellowships in Cancer Research also are awarded by the American Cancer Society upon recommendation by the Committee on Growth. They are offered to citizens of the United States for advanced study in Great Britain in specialized fields pertaining to the problem of growth. Similar fellowships are awarded by the British Empire Cancer Campaign to young British scientists for research in the United States.

Fellowships in the Medical Sciences supported by the Rockefeller Foundation are administered by the Medical Fellowship Board of the division. Fellows are expected to devote themselves to research in the basic medical sciences. The awards are open to citizens of the United States and Canada.

Fellowships in Tuberculosis are also administered by the Medical Fellowship Board under a grant from the National Tuberculosis Association. These awards are designed to promote the development of investigators in fields related to tuberculosis. They are open to citizens of the United States who are graduates of American schools.

Fellowships in Radiological Research are administered for the James Picker Foundation by the division's Committee on Radiology. Applications will be entertained from candidates seeking to gain research skills leading to investigative careers in radiology. Appointments are not limited to United States citizens.

Applications for 1956–57 under any of these programs *must be postmarked on or before 1 Dec. 1955*. Fellowships are awarded in the early spring. Complete details and application blanks may be obtained from the Fellowship Office, National Academy of Sciences–National Research Council, 2101 Constitution Ave. NW, Washington 25, D.C.

■ The New York Heart Association will offer three senior fellowships this fall, each for a period of 3 years and renewable for an additional 2 years. These fellowships carry annual stipends that start at $6000 and annual increments of $500.

The awards are for full-time work and are available to men and women under the age of 35 who have attained a doctoral degree, who have demonstrated a competence for research, and who have a definite orientation toward fundamental research in the cardiovascular field. Research programs are to be carried out in recognized institutions within the area of the five boroughs of New York.

For further information, write to the Medical Director, New York Heart Association, Inc., 485 Fifth Ave., New York 17. *Closing date for applications is 31 Oct.*

In the Laboratories

■ The Atomic Energy Commission plans to procure additional quantities of high-purity zirconium and hafnium to meet the increasing requirements of its reactor-development program and of currently scheduled naval projects. Tentative plans provide for solicitation of proposals for delivery of 2 million pounds of zirconium over a 5-year period or 1 million pounds over a 3-year period.

Proposals should also cover delivery of as much hafnium metal as can be produced from the zirconium to be processed. Any production process that meets the specifications for the end products will be considered.

Present plans call for issuance of an invitation for proposals in November 1955, with receipt of proposals by February 1956. The deadline for starting deliveries is expected to be July 1957.

The AEC at present has a contract with the Carborundum Metals Co., Inc., of Akron, N.Y., for delivery of 200,000 pounds of zirconium and 4000 pounds of hafnium per year. The new procurement will be in addition to this amount.

Prospective bidders are advised to familiarize themselves with the current status of zirconium and hafnium technology and the present and future market for the metals. In addition to the metal to be purchased by the AEC, quantities of zirconium and hafnium may be required for privately financed nuclear power projects. The AEC does not intend to provide zirconium or hafnium for such projects.

Preliminary schedules and further information are contained in a *Prospectus for Procurement of Zirconium and Hafnium*, copies of which may be obtained from the Pittsburgh Area Office, U.S. Atomic Energy Commission, Box 1105, Pittsburgh 30, Pa.

■ A 2-million-volt Van de Graaff positive-ion accelerator has been delivered to the Junta de Energia Nuclear of Spain by High Voltage Engineering Corp., Cambridge, Mass. The machine, to be used in a study of light nuclei, is installed at the Centro Nacional de Energia Nuclear de la Moncloa, where a program is under direction of Carlos Sanchez del Rio.

High Voltage is building a similar accelerator, one of 3-million-volts, for the Weizmann Institute of Science in Rehovoth, Israel. The unit, which is to be delivered next year, will be installed in the new nuclear physics department building that is now under construction at the institute.

■ The H. J. Heinz Co. has announced plans for the construction of a new Heinz Research and Quality Control Center. The $3-million structure will be built at the company's Pittsburgh headquarters and will serve as the research and development center for Heinz's domestic and international operations.

The center, which is scheduled for completion by Jan. 1957, will contain a pilot plant, experimental kitchens, research laboratories, quality control laboratories, and the scientific library of the company's research and quality control division. After the completion of the new facility, all laboratory and research activity will be gathered under one roof except for crop research, which will remain at the experimental farms in Ohio.

■ The Bell Aircraft Co., Inc., and the Nuclear Science and Engineering Corp., have announced that they have entered into an agreement through which Nuclear Science and Engineering will render nuclear assistance and advice to Bell. The purpose of this relationship will be to evaluate the applicability of nuclear techniques to Bell's present programs as well as the potential application of Bell's existing technical manpower and facility capabilities in the atomic energy field.

Miscellaneous

■ The proceedings of the International Conference on the Peaceful Uses of Atomic Energy, held in Geneva in August 1955, will be published by the United Nations in 16 volumes of approximately 500 pages each. The volumes will constitute a complete, unabridged record of the conference, and will include all papers that were submitted, whether they were presented orally or not, together with a record of the discussions concerning each paper.

This record will be published in several languages; the English edition will be available in the beginning of 1956, the others at a later date still to be determined. Any of the individual scientific papers, in mimeographed form, may be purchased from the United Nations Bookshop at 25 cents each.

The following are the tentative titles for the proceedings, in chronological order by volume: The World's Requirements for Energy; The Role of Nuclear Power; Physics, Research Reactors; Power Reactors; Cross Sections Important to Reactor Design; Physics of Reactor Design; Geology of Uranium and Thorium; Nuclear Chemistry and the Effects of Irradiation; Production Technology of the Materials Used for Nuclear Energy; Reactor Technology and Chemical Processing; Radioactive Isotopes and Nuclear Radiations in Medicine; Biological Effects of Radiation; Radioactive Isotopes and Ionizing Radiations in Agriculture, Physiology, and Biochemistry; Legal, Administrative, Health and Safety Aspects of Large Scale Use of Nuclear Energy; General Aspects of the Use of Radioactive Isotopes, Dosimetry; Applications of Radioactive Isotopes and Fission Products in Research and Industry; and Record of the Conference.

A special prepublication price of $110 (£39, F. 450 Swiss) for the full series has been established. This will be protected for all advance orders received up to 31 Dec. 1955. Orders for the full series, or for individual volumes (final prices to be announced) may be placed with the United Nations sales agents or the United Nations Headquarters Bookshop, United Nations, N.Y.

■ *Results of 1954 Fungicide Tests*, a bound compilation of a series of articles that appeared in *Agricultural Chemicals*, April through June, may be purchased for $1 from Dr. D. A. Roberts, College of Agriculture, Cornell University, Ithaca, N.Y. The publication of these results is under the sponsorship of the American Phytopathological Society. This year Roberts is in charge of the project, which is a continuation of the publication of results formerly provided through a supplement of the *Plant Disease Reporter* of the Plant Disease Epidemics and Identification Section, U.S. Department of Agriculture.

■ Because of infestation by the European chafer, on 1 Sept. parts of Connecticut, New York, and West Virginia were placed under Federal quarantine restrictions by the U.S. Department of Agriculture. Woody and herbaceous plants of all kinds, parts of these plants, all types of soil, and other articles or materials likely to harbor this serious agricultural pest now require certification based on treatment, inspection, or nonexposure to infestation. The European chafer was first recognized in this country in New York in 1940; it was found in Connecticut in 1951, and in West Virginia in 1954. In the white grub stage, it is known to feed extensively on fine roots and root hairs of small grains, grasses, and clover and other legumes, seriously damaging pastures, lawns, and golf courses. Turf injury by the insect closely resembles that of such pests as the Japanese beetle, the rose chafer, and various species of white grubs. The adults, light tan beetles about ½-inch long, emerge in swarms at dusk in midsummer.

■ Hugo Freund has published in Germany an 8-volume *Handbook of Microscopy in Technology*. This series may be obtained from E. Leitz, Inc., New York, at $30 to $40 a volume.

■ Laboratories of the Department of Defense in New England have announced the availability of career opportunities for physical science and biological science administrators. The openings carry Civil Service ratings that range from GS-13 to GS-16; salary range is from $8360 to $12,000 per year. For information write to the Director, First U.S. Civil Service Region, Post Office and Courthouse Building, Boston 9, Mass.

Reports and Letters

Relabeling of Cis and Trans Isomers of 1,3-Dimethylcyclopentane

Evidence pointing to the necessity of relabeling the *cis* and *trans* isomers of 1,3-dimethylcyclopentane has recently been presented (*1*, *2*). The findings may be summarized as follows.

1) Birch and Dean (*1*) prepared an optically inactive *cis* form of 1,3-dimethylcyclopentane through reduction of *cis*-cyclopentane-1,3-dicarboxylic acid that was obtained by oxidation of bicyclo-[2.2.1]-2-heptene (*3*). This *cis* isomer boiled at the same temperature as, and had physical properties similar to those of, the compound presently designated as the *trans* isomer of 1,3-dimethylcyclopentane (*4*). Employing the method of Pospischill (*5*), Birch and Dean isomerized *cis*-cyclopentane-1,3-dicarboxylic acid to the racemic *trans*-acid with hydrochloric acid. After purification, the racemic *trans*-acid was resolved into *d* and *l* forms that had optical rotations, for the D line of sodium at 15°C, of +21.3° and −22.6°, respectively. The corresponding *trans* isomers of 1,3-dimethylcyclopentane derived from them were optically active and had higher boiling points, higher densities, and higher refractive indices than those of the *cis* isomer. A direct comparison of infrared spectra made by Birch and Dean further confirmed the identity of the two geometric isomers and established that the isomer hitherto designated as *trans* is actually *cis*.

2) On the basis of consideration of the relative energies of the two molecules, Haresnape (*2*) concluded that the *trans* isomer has a greater energy. It is assumed (*6*) that any chain of four carbon atoms with tetrahedral bond angles has a minimum energy when the atoms lie in a planar, zigzag configuration. Any departure from this arrangement can be regarded as a rotation about the central C—C bond. The departure increases the energy of the molecule by an amount that measures the strain energy of rotation. The molecular structure of the cyclopentane ring (*7*) is believed to be one in which four carbon atoms are nearly in a plane and the fifth is displaced above or below this plane. This puckering is regarded as rotating around the ring. Following Beckett, Pitzer, and Spitzer (*6*), and ignoring combinations of carbon atoms involving the ring only, which are identical in the two cases, Haresnape (*2*) considered the average molecule of the *cis* isomer as containing four chains of four carbon atoms distorted by 30° from the planar zigzag configuration and the average molecule of the *trans* isomer as containing three chains distorted by 30° and one chain distorted by 90°. Interpolation between the values of strain energy for 0° and 120° given by Beckett, Pitzer and Spitzer (*6*), and for 180° given by Pitzer (*8*), gives values for 30° and 90° of 0.1 and 0.6 kcal/mole, respectively. Thus the difference in energy between the two isomers is calculated as 0.5 kcal/mole, with the *trans* form having the greater energy. This value is in agreement with the experimental value of 0.54 ± 0.24 kcal/mole (*9*, *10*), at 25°C, provided that the names *cis* and *trans* are reversed.

Similar studies made by us along the lines of Haresnape show that the molecule of the *trans* form should in fact be represented as containing, on the average, 14/5 or 2.8 chains of four carbon atoms distorted by 30° and 6/5 or 1.2 chains distorted by 90°. This gives 0.6 kcal/mole for the difference in energy between the *trans* and *cis* isomers, which also agrees with the experimental value, provided that the names *cis* and *trans* are reversed.

It is a matter of experimental fact that, among pairs of geometric isomers, the one possessing less steric hindrance has the lower energy content and usually has the lower boiling point, lower density, and lower refractive index. In light of the information given here, it can be concluded that the *cis* and *trans* isomers of 1,3-dimethylcyclopentane should be relabeled.

For these reasons, a change was made on 30 April 1955 in the naming of the *cis* and *trans* isomers of 1,3-dimethylcyclopentane in the tables of physical and thermodynamic properties, and in the catalogs of spectral data issued by the American Petroleum Institute Research Project 44 at Carnegie Institute of Technology. The changes are such that the lower boiling isomer, formerly labeled *trans*, is now labeled *cis*, and the higher boiling isomer, formerly labeled *cis*, is now labeled *trans*.

The following notations will be used in the tables and catalogs of spectral data listing these compounds (*11*): (i) 1,*cis*-3-dimethylcyclopentane (this isomer, formerly labeled *trans*, has the following properties: boiling point at 1 atm, 90.77°C; refractive index, n_D at 25°C, 1.4063; density at 25°C, 0.7402 g/ml.) (ii) 1,*trans*-3-dimethylcyclopentane (this isomer, formerly labeled *cis*, has the following properties: boiling point at 1 atm, 91.72°C; refractive index, n_D at 25°C, 1.4081; density at 25°C, 0.7444 g/ml).

The naming of these compounds follows the new system (*12*). In addition to the foregoing changes in connection with the work of the American Petroleum Institute Research Project 44, corresponding changes have been made in the work of the American Petroleum Institute Research Project 6. Accordingly, the names of the API standard samples and API research samples of the *cis* and *trans* isomers of 1,3-dimethylcyclopentane have been reassigned. The National Bureau of Standards, which also issues these compounds as NBS standard samples, is accepting this notation.

All workers in other laboratories dealing with 1,*cis*-3-dimethylcyclopentane or 1,*trans*-3-dimethylcyclopentane are invited to relabel these two compounds in the manner described. It is also recommended that, whenever either of the two names is written, one or more properties also be recorded for adequate identification apart from the name *cis* or *trans*. This latter step will completely eliminate any confusion that may arise from this relabeling. Similar changes were made several years ago for the *cis* and *trans* isomers of 1,3-dimethylcyclohexane (*13*).

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2 May 1955

Temperature Profiles Throughout Cigarettes, Cigars, and Pipes

The recent interest in a correlation between cigarette smoking and cancer, such as the isolation of carcinogens from cigarette paper, prompts me to offer some evidence I obtained on this subject. During a lull in some work I was doing at the Whiting Laboratories of Standard Oil (Indiana), I had a high-speed, high-temperature Micromax recorder at my disposal, which I used to measure the temperature profiles throughout cigarettes, cigars, and pipes. Since I have never found any mention of these temperatures, I believe that other readers may be interested in them. I found as much as a 300°C difference between the "hot spots" in a cigarette and those in a pipe. Most moderately priced cigars had "hot spots" approaching that of cigarettes.

The temperature profile throughout the burning tobacco was measured by the insertion of six glass-coated 28-gage chromel-alumel thermocouples throughout the tobacco bed. The temperature-time curves were then recorded on the Micromax recorder as the tobacco was smoked. In this way, as the "hot spot" approached a given thermocouple its temperature rapidly rose and then dropped as the "hot spot" passed. The over-all burning temperature was then considered to be the average of the maximum temperature reached by all six thermocouples. The six maximum temperatures so measured were all within 10°C of one another.

The popular brands of cigarettes had "hot spots" that varied between 610°C and 740°C, depending on the brand. The temperature of the gases entering the mouth varied from 50°C to 70°C, also depending on the brand of cigarette. The temperature-time curves were smooth curves showing no discontinuity.

Repetition of this same procedure with low-priced cigars showed the same maximum temperature range of the "hot spot," from 600°C to 660°C, with the gases entering the mouth at 40°C to 60°C. More expensive cigars showed maximum temperatures from 580° to 610°C.

Highly aromatic pipe tobacco showed a maximum temperature of 540°C to 590°C, while untreated, nonaromatic tobaccos showed a "hot spot" in the pipe of only 420°C to 450°C. The temperature of the gases at the bottom of the pipe bowl at the entrance to the stem was as low as 30°C with some tobaccos and ranged up to 50°C. However, in all tobaccos examined, the temperature of the gases from pipe tobacco was lower than that of the gases from a cigarette. I believe that the wide difference in aromatic and nonaromatic pipe tobacco and the wide temperature difference between cigarettes and pipes must be due, in part, to the potassium chlorate used to treat cigarette tobacco in order to insure even and continued burning. The aromatic odorant used to treat aromatic pipe tobacco may be responsible for the increased temperature of the "hot spot" found in aromatic pipe tobaccos.

Having thus established the temperature range in the "reaction zone" in tobacco, one might conclude that the carcinogenicity of cigarettes over pipe tobacco is due to the 300°C higher temperature found in cigarettes. However, most cigars also show the 600°C "hot spot," and recent evidence would tend to indicate that cigars are not carcinogenic. Since the 600°C temperature range in cigarettes is more than sufficient to decarboxylate or decarbonylate pyridine or pyran carboxylic acids or aldehydes, it would seem possible, from a chemical viewpoint, that the carcinogenic pyrans and pyridines arise from the cigarette paper. Furthermore, in view of the extreme high temperatures in cigarettes, thermal cracking to yield free radicals which could subsequently dehydrocyclize to yield condensed ring carcinogens is not an unreasonable postulate.

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31 December 1954

Aureomycin in the Saliva of Dairy Calves after Intramuscular Injection of the Antibiotic

In a preceding study, Radisson (*1*) showed that during continuous feeding of terramycin to dairy calves, high concentration of the antibiotic could be detected in both feces and urine. Rusoff *et al.* (*2*) reported that Aureomycin (*3*), following either oral administration or intramuscular injection, also could be detected in both of these forms of excreta. Since growth stimulation was obtained whether Aureomycin was given orally or intramuscularly, the latter authors assumed that injected Aureomycin "by-passed" the rumen and concluded: "The mode of action of Aureomycin in stimulating growth in the young calf is not due to its action in the rumen." In view of the evidence presented by Bender *et al.* (*4*) that saliva from human beings who had been injected intravenously with Aureomycin contained significant quantities of this antibiotic, an attempt was made to determine whether the same might occur in the young calf (*5*).

In preliminary work attempts were made to detect Aureomycin in the saliva of several calves after intramuscular injection of the antibiotic. The standard paper-disk method for assay of antibiotics was used, with spores of *B. subtilis* (ATCC No. 6633, DIFCO) as the test organism; considerable difficulty was experienced in consistently detecting small quantities of Aureomycin in the saliva. But, when the cup-plate method was used, with spores of *B. mycoides* (*6*) as the test organism, and when the saliva sample was adjusted to *p*H 6.5, it was possible to detect Aureomycin concentrations as low as 0.05 μg/ml.

The results reported here (Table 1) involved four ruminating calves, 7 to 9 weeks of age, that consumed 2 to 5 lb of a grain mixture, plus hay, daily. A single dose of 2 g of Aureomycin HCl in sesame oil was injected intramuscularly (in the semitendinosus of the hind leg) into each calf immediately after the morning feeding. Samples of saliva, approximately 15 ml each, were collected at intervals of 0.5, 1, 2, 3, 5, 8, 12, and 24 hours after injection of the antibiotic. The samples were stored immediately in a freezer and kept frozen until completion of all the collections from each calf. Standard curves were prepared by plotting the size of the zones of inhibition produced by known quantities of Aureomycin added to saliva, which had been obtained from calves receiving no Aureomycin, and which also had been adjusted to *p*H 6.5.

As early as ½ hour after intramuscular injection of Aureomycin, the antibiotic was detected in the saliva of three of the four calves (Table 1). From 2 to 8 hours after injection, with one exception, Aureomycin was present in the saliva of all four calves at all collections. At 12 hours, the antibiotic was still detected in

Table 1. Concentration of Aureomycin found in the saliva of dairy calves following intramuscular injection of the antibiotic

Calf No.	Breed	Weight (lb.)	Concentration of Aureomycin in saliva (μg/ml)							
			Hours after injection							
			0.5	1	2	3	5	8	12	24
1	Jersey	90	0.25	0.35	0.15	0.00	0.05	0.10	0.10	0.00
2	Jersey	101	0.00	0.00	0.10	0.20	0.15	0.20	0.00	0.00
3	Guernsey	130	0.05	0.05	0.10	0.25	0.05	0.05	0.00	0.00
4	Ayrshire	115	0.10	0.20	0.25	0.20	0.10	0.10	0.10	0.00

the saliva of two of the calves, but after 24 hours none of the antibiotic was found in any of the calves.

Since the Aureomycin was found in the saliva, some of the antibiotic would necessarily pass into the rumen and consequently might have some effect on the rumen microflora. The effects of antibiotics on rumen microflora and on efficiency of digestion *in vitro* and *in vivo* have been studied, and reports are in preparation. In the continuation of the work of Rusoff *et al.* (2), it was reported by Hester *et al.* (7) that Aureomycin could not be detected in the rumen following intramuscular injection of Aureomycin. It is possible that the failure of the latter authors to detect Aureomycin in the rumen contents of slaughtered animals might be ascribed to the considerable dilution of saliva after it passes into the rumen, to the smaller amounts of Aureomycin injected, to a possibly less sensitive assay technique than that described in the saliva analyses reported here, or to a combination of all three factors.

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14 March 1955

Methylpentynol (Oblivon) in the Treatment of Epilepsy

In 1952 R. W. Schaffarzick and B. J. Brown [*Science* **116**, 663 (1952)] published reports of experimental and clinical trials that suggested that methylpentynol might be of use in the treatment of epilepsy. They also noticed that two of the six patients under treatment developed strongly positive cephalin flocculation tests, which rapidly became negative when the drug was discontinued, suggesting that this drug might have toxic effects on the liver. As a result of this report the effect of methylpentynol on patients with epilepsy was further investigated and the effect of the drug on liver function tests was observed.

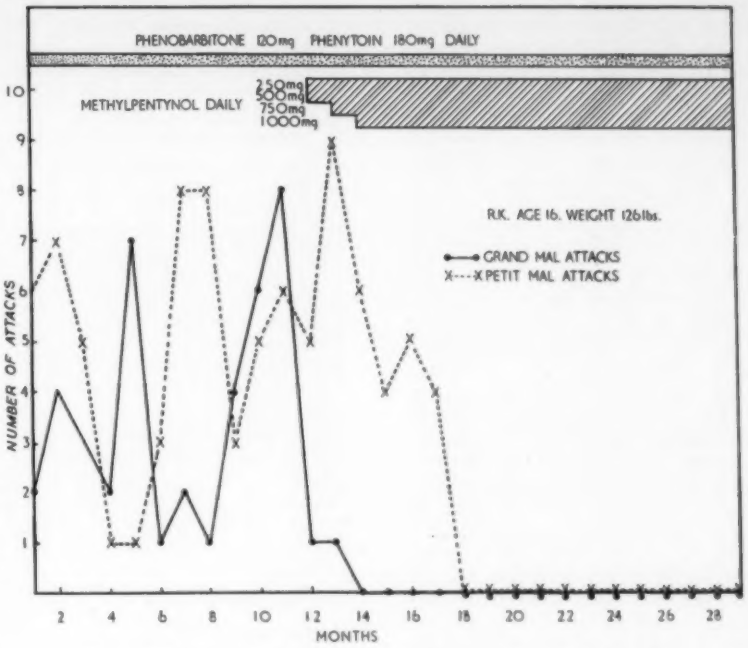

Fig. 1. Effect on epileptic patients of treatment with methylpentynol.

Six children of ages between 11 and 16 years and 18 adult males were treated. All but one of the patients had both grand and petit mal; five had, in addition, psychomotor attacks; the remaining one had psychomotor epilepsy only. Methylpentynol was given by mouth, the dosage being increased up to 1000 mg daily, and treatment was continued for 3 months. In only one patient, a boy of 16, did methylpentynol appear to control the epilepsy; the number of attacks and effect of treatment are shown in Fig. 1. He has now been under treatment with methylpentynol for a further 9 months as an outpatient and has had no further fits. Full empirical liver function tests were performed on all the children at regular intervals up to 3 months and on 10 of the adults at the end of 3 months. No abnormality was found.

Two of the children became sleepy and depressed while they were under treatment; they were inclined to stagger and fall easily. When the drug was omitted they rapidly regained their former wakefulness and spirits.

It is concluded that methylpentynol is unlikely to be useful in controlling epilepsy in patients who have proved resistant to the more usual form of treatment, but that it has no toxic effects on the liver, as far as these tests have shown.

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6 January 1955

γ-Sitosteryl Glycoside in Tobacco

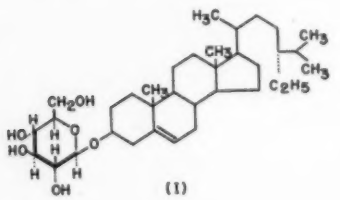
The Indian Cancer Research Centre has been interested for the last 10 years in determining the role of tobacco in the production of oral cancer (*1*). With this object in view, a detailed study of the chemistry of tobaccos that are used for chewing purposes by the people of India has been in progress for the last 2 years. One of the varieties of tobacco extensively used for chewing by the people living in Malabar (southwest coast of India) is known as "Vadakkan" (*Nicotiana tabacum*).

We have now found that it contains a sterol glycoside (I) not so far isolated from tobacco. The glycoside (I) is insoluble in water, sparingly soluble in non-hydroxylic solvents, and crystallizes from alcohol in colorless plates, mp 215°–235°C (found: C, 72.1; H, 10.4; calcd. for $C_{35}H_{60}O_6$: C, 72.8; H, 10.5 percent). Yield 0.01 to 0.02 percent. It yields tetra-acetyl derivative, crystallizing from dilute alcohol in lustrous plates, mp 149°C

(found: C, 69.2; H, 8.8; calcd. for $C_{43}H_{68}O_{10}$: C, 69.3; H, 9.1 percent).

The glycoside is hydrolyzed into a reducing sugar and an aglycone (II) on boiling with 20-percent hydrochloric acid for a few minutes or on standing overnight with cold concentrated hydrochloric acid. The sugar formed an osazone mp 208°C, which on mixing with glucosazone (*2*), prepared from D-glucose, showed no depression in melting point and was identified as D-glucose. The aglycone (II) crystallized from dilute alcohol in shining plates, mp 148°C (found: C, 83.9; H, 12.1; calcd. for $C_{29}H_{50}O$: C, 83.97; H, 12.2 percent). α_D^{29}, −43.8 (109 mg in 5 ml chloroform). It gives a green coloration in Liebermann-Burchard test and yields an acetyl derivative, mp 140°C (found: C, 81.6; H, 11.3; calcd. for $C_{31}H_{52}O_2$: C, 81.6; H, 11.4 percent). These properties of (II) suggested that it might be γ-sitosterol (*3*). Phytosterols (i) mp 62°–63°C in tobacco leaves (*4*), (ii) mp 140°–141°C in tobacco seeds (*5*), and (iii) mp 135°C in tobacco tar (*6*), differing in melting points from the one now obtained by us were detected by earlier workers; however, the constitution of these products had not been determined by them.

On the basis of the experimental evidence presented here, it followed that (I) is γ-sitosteryl-D-glucoside and, assuming the suggested constitution (*7*) of γ-sitosterol as correct, (I) could be represented as follows:



(I)

The formation of the tetraacetyl derivative by (I) is evidently the result of acylation of the hydroxyl groups in the sugar radical. The sterol residue with the fatty chain on carbon atom 17 appears to have suppressed the solubilizing character of the hydrophyllic sugar residue on the carbon atom 3 and rendered (I) insoluble in water. The occurrence of "γ"-sitosteryl glycoside does not seem to be as common in plant products as that of the "β"-sitosteryl glycoside (*8*).

Description of the isolation of (I) and details of the foregoing work are in preparation (*9*).

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8. M. B. Matlack, *Science* **81**, 536 (1935) (sweetpotato); K. Kondo and S. Mori, *J. Chem. Soc. (Japan)* **57**, 1128 (1936) (soybean); K. S. Markley and Ch. E. Sando, *J. Biol. Chem.* **119**, 641 (1937) (cuticle of cherry); H. Staub, *Helv. Chim. Acta* **25**, 649 (1942) (mandrake root); L. J. Swift, *J. Am. Chem. Soc.* **74**, 1099 (1952) (orange juice).
9. We are indebted to the National Cancer Institute of the U.S. Public Health Service and to the Indian Council of Medical Research for their financial support in this work.

22 November 1954

Diffusion Constant and Diffusion Coefficient

Jacob Verduin shows correctly how Krogh's diffusion constant differs from the diffusion coefficient (*1*). However, he states, incorrectly, that Krogh failed to distinguish between his diffusion constant and the diffusion coefficient, and he complains that the "unfortunate use of tension units . . . in Krogh's diffusion constant" led many biologists to believe that in aquatic media CO_2 has a higher diffusivity than O_2.

With the present note I wish to demonstrate that Krogh very clearly distinguished between his diffusion constant and the diffusion coefficient of Hüfner—which is now often called diffusivity—and that Krogh's choice of his diffusion constant was carefully considered and justified.

In his original paper, "The rate of diffusion of gases through animal tissues, with some remarks on the coefficient of invasion" (*2*), Krogh discussed Exner's work (1875). Exner found that the rates of diffusion of different gases in the same fluid are proportional to the absorption coefficients of the gases in the fluid and inversely proportional to the square roots of their molecular weights. Krogh cited Hüfner's definition of diffusion coefficient, namely, "the quantity diffusing through 1 cm^2 and 1 cm thickness in 24 hours when the pressure difference is 1 atmosphere, divided by the absorption coefficient for the gas in question."

Krogh gave a major reason why he regarded Hüfner's diffusion coefficient as impractical for physiological work, namely, "the absorption coefficients for gases in tissues are generally unknown and their accurate determination [is] very difficult." Krogh then showed how, *for water*, his diffusion constants can be calculated from Hüfner's diffusion coefficients. Evidently, Krogh not only clearly distinguished between his diffusion constant and the diffusion coefficient of Hüfner, but he also gave, for water, the quantitative relationship between the two units.

Krogh's statement that the differences in CO_2 pressure in animal tissue and blood must be an absolutely negligible quantity is taken by Verduin as a proof that Krogh failed to distinguish between his diffusion constant and the diffusion coefficient, because, argues Verduin, the concentration gradient required to achieve a given CO_2 transport must be higher, not lower, than for the same O_2 transport.

The latter sentence is true enough but when Verduin used it to prove Krogh's failure, he apparently had forgotten a major point of his own article, namely, that Krogh dealt with pressure gradients, not concentration gradients. Since the solubility in water of CO_2 is 28 times as great (at 20°C) as that of O_2, a given difference in concentration of CO_2 in water is achieved for CO_2 with only one-twenty-eighth of the difference in pressure required for the same difference in concentration of O_2 in water; and this may be absolutely—that is, in terms of atmospheres—negligible.

Krogh (*2*, p. 401) discussed Hüfner's idea that diffusion rates of gases in water should be smaller at higher temperature because increase of temperature decreases the solubility of the gases in water. Krogh stated that the effect of decreasing solubility with higher temperature might be offset by a "decrease in the internal friction of the water"—which would mean an increase in diffusivity. With the peritoneal membrane from small dogs, Krogh measured the effect of temperature on his constant for oxygen diffusion in animal tissues. Taking the diffusion constant at 20°C as unity, the constant at 0.2° to 0.5°C was 0.79 ± 0.02 and that at 36° was 1.16 ± 0.05. Based on these measurements Krogh, and later Prosser *et al.* (*3*), could conclude that the diffusion constant of oxygen in tissue increases about 1 percent per degree increase of temperature above 20°C. Verduin in his recent communication (*1*, p. 216) writes "This statement is false."

What led Verduin to this devastating verdict? It looks as if he did not realize that Krogh *measured* the temperature effect on his diffusion constant; it looks as if he presumed that Krogh had calculated his results on animal tissue from data of the temperature effect on diffusivity in water and that in this calculation Krogh had failed to account for temperature effect on solubility. Whatever

the reason, Verduin's pronouncement "This statement is false" is as erroneous and unfortunate as his allegation that Krogh failed to distinguish between his diffusion constant and diffusivity.

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28 April 1955

In a communication "Diffusion constant and diffusion coefficient" [*Science* **121**, 215 (1955)] J. Verduin criticizes the use of diffusion constants for gases in tissues based on partial pressures (tensions).

Diffusion constants based on partial pressures were introduced by A. Krogh [J. Physiol. **52**, 391 (1919)], who fully understood the difference between a constant so defined and one based on concentration gradients. He choose partial pressures because the absorption coefficients of gases in tissues were—and still are—generally unknown and difficult to determine, which makes the use of concentration-based coefficients impractical in physiological reasoning. Moreover, one of the most important of the diffusion problems of Krogh's time—respiration—necessitates comparison between air and blood, which can hardly be done except on the basis of partial pressure.

Verduin also criticizes Krogh's statement that the diffusion constant as defined by him increases about 1 percent for each centigrade degree increase in temperature. Using the diffusivity and the solubility of oxygen, Verduin calculates the diffusion constant for oxygen in water at 20°C and 30°C as defined by Krogh and finds the values to be 0.346 and 0.338, respectively, which is in contrast with Krogh's statement.

Krogh's statement on the influence of temperature refers, however, to animal tissues and is based on actual determinations that he undertook because the influence of temperature on the solubility of gases in tissues and on the internal friction of the tissues themselves is impossible to calculate.

Krogh was, of course, fully aware that the diffusion rates for the different gases are inversely proportional to the square roots of their molecular weights and of other differences between the constants as defined by him and by the physicists.

Verduin is correct in his statement that the gradient in molecular concentration necessary for the transport of carbon dioxide from the tissues to the capillaries is somewhat greater for carbon dioxide than for oxygen, but translated into partial pressure this concentration gradient is, as Krogh said, absolutely negligible.

It would, of course, be possible to introduce diffusion constants for gases based on concentrations into physiology, but I doubt that it would be practical to give up the use of partial pressures, which for the understanding of the diffusion of gases between alveoli and blood is unavoidable and which we use also in other problems (O_2 dissociation curve of hemoglobin).

However, in order to avoid confusion it would perhaps be useful in every case to state definitely which of the two diffusion constants is used, for example, by denoting the old diffusion coefficient of the physicists—"the Fick diffusion constant" defined as the quantity diffusing through an area of 1 cm² and a thickness of 1 cm in unit time, when the concentration difference is unity—and the one used by the physiologists in the case of gases—"the Krogh diffusion constant" defined as the quantity diffusing through an area of 1 cm² and a thickness of 1 μ/min, when the partial pressure difference is 1 atm.

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15 March 1955

Ultrasonic Lesions in the Mammalian Central Nervous System

Early histological studies of nerve tissue of animals irradiated with intense focused ultrasound at this laboratory indicated that nerve cell bodies were more susceptible than nerve fibers to changes by the ultrasound (*1*). These preliminary histological results have not been substantiated in subsequent studies. Rather, it has been found, as was previously reported (*2*), that white matter is more readily affected by the sound and that higher ultrasonic dosages are required for producing changes in gray matter. It can be readily seen that this selectivity provides a unique tool for basic neurological studies. Recent publications of this laboratory present results on the production and time sequence of changes in relatively large white-matter lesions of controlled shape (*2, 3*). This paper, however, is concerned primarily with small ultrasonic lesions in both gray and white matter (*4*).

Selective, accurately positioned lesions as small as 2 to 3 mm in maximum diameter can be produced. The lesions, which can be localized at any desired depth in the brain without affecting intervening tissue, are quantitatively reproducible from one animal to another, so that dosage studies made on a series of animals can be used as a guide in choosing the conditions of irradiation for neuroanatomical or functional studies. The blood vessels are most resistant to the action of the sound. It is, therefore, possible to interrupt fiber tracts without destroying neighboring gray matter and without breaking blood vessels even within the site of the lesion. It is also possible, by appropriate choice of the ultrasonic dosage, to affect irreversibly the nerve tissue (fibers and cell bodies) in gray matter without causing hemorrhage.

Fig. 1. Small ultrasonic lesion in the subcortical white matter of the brain of a cat. Dosage used selectively affects the fiber tracts, and no damage is produced in the neighboring gray matter. (PTAH stain)

The results reported here were obtained from histological studies of ultrasonically irradiated cats and monkeys. Extensive dosage studies have been completed, and the time course of development of the lesions has been followed in animals sacrificed from immediately after irradiation (5 min) up to 30 days. The preparation of the animal and the technique of irradiation are described in previous papers (*2, 3*). Results of investigations concerned with the physical mechanism of the action of the sound on the nerve tissue have been published (*5*).

When a region of the white matter of the central nervous system is irradiated at one spot with a single exposure of ultrasound at a dosage just above the minimum required to produce an effect, a small lesion about 2 to 3 mm in maximum diameter is produced. Figure 1 illustrates such a lesion in the subcortical white matter 12 days after irradiation (dose 51 atm acoustic pressure and $4.8(10)^3$ cm/sec acoustic particle velocity for 1.00 sec). It shows a sharp boundary between the affected white matter (lower end) and the neighboring unaffected gray matter.

A lesion such as that shown in Fig. 1 is first seen 10 to 15 min following irradiation in tissue sections prepared with Weil's myelin stain. The lesion area is first recognized as a light-staining matrix as compared with normal tissue. One hour after irradiation the myelin sheaths appear beaded. The perivascu-

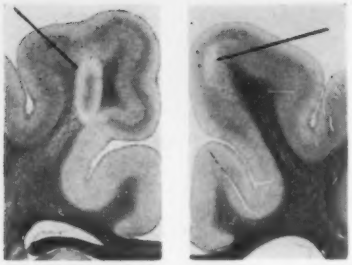

Fig. 2. Ultrasonic lesion in the subcortical white matter of a cat brain exhibiting a central region of dark-staining fibers and some invasion of neighboring gray matter. (PTAH stain) Fig. 3. Small ultrasonic lesion in the cortical gray matter of a cat brain. (PTAH stain)

lar spaces are dilated, and some separation appears between the fibers. Within 6 to 12 hr (depending on the dosage) the myelin sheaths break down into separated spheres. During this same period axis cylinder fragments increase in the lesion area. These changes are followed by the hematogenous and microglial responses until all of the debris is cleared away. Other neuroglia then form a glial scar.

A greater dosage (53 atm acoustic pressure and $4.9(10)^3$ cm/sec acoustic particle velocity for 1.50 sec) produces a slightly larger lesion containing a central normal staining area or island of myelinated fibers surrounded by a zone or moat containing completely disrupted nerve tissue and large clear fluid-filled spaces (Fig. 2). No hemorrhage is present. These more severe lesions may involve neighboring gray matter, causing changes that are described in the following paragraphs. Lesions of the same order of size can be produced in fiber tracts at any depth in the brain without affecting the intervening nervous tissue.

Figure 3 illustrates a small lesion produced by ultrasound in the cerebral cortex of a cat. To produce such a lesion in gray matter, greater dosages of ultrasound are required than for white matter. When a region of gray matter is irradiated with a single exposure at a dosage (53 atm acoustic pressure and $4.9(10)^3$ cm/sec acoustic particle velocity for 2.50 sec) above the minimum required to produce a lesion, the effects that appear first (10 min after exposure) are a lightening in the staining ability of the background matrix and a slight dilation of the perivascular spaces. Nerve cells stain more faintly than normal within 1 hr. Many contain large clear vacuoles in their cytoplasm; others have ruptured cell membranes, and only ragged strands of cytoplasm remain around the still intact nucleus. The nerve cells have disappeared by the end of 1 day. The background contains many clear spaces, and in the more severe lesions large fluid-filled clefts may appear in the tissue. The myelin sheaths and axis cylinders of nerve fibers begin to break down within 1 hr and undergo the afore-described changes for white matter. Some blood-filled capillaries are present at 1 hr. The hematogenous response is manifest within 6 hr by the presence of leucocytes. Microglial multiplication is evident at 4 days, and 12 days after irradiation the glial response is well developed.

The ultrasonic method of producing localized selective lesions in the central nervous system constitutes a unique and potent tool for experimental neurological and neurosurgical applications (*6*). The technique is currently being used in this laboratory in a variety of neurological studies.

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6. No commercial equipment is yet available.

11 April 1955

Basic Research versus Pure Research

The recent article by Spaght (*1*) reemphasizes the need for a formalization of concepts concerning words used to describe research and science. Spaght distinguishes between "pure" and "basic" research, although many persons would probably consider the two as equivalent. Spaght's "basic" research is equivalent to the "pioneer," or Edisonian, research as I defined it (*2*).

The current integration of science into the social structure is being highly hindered by the misuse of these and many other terms (*3*). Scientists realize generally that the vocabulary of science must be defined explicitly. Yet many will use terms loosely when they are considering general problems of science. How many scientists could give a satisfactory answer if they were asked to explain what this science of theirs is? Is it any wonder then that nonscientists are confused in their "understanding of science"?

Most efforts in this direction have been made by professional philosophers, to whom much credit is due. Yet the result has been that articles on science, such as those in leading encyclopedias, are almost unintelligible to practicing scientists. Problems and concepts of great importance have been left unconsidered because they could be apparent only to actual research workers.

No criticism of individuals is intended. Spaght and others have the right to define terms as long as no general agreement has been reached. The scientific profession as a whole, however, has been highly lax in developing its own understanding of the general operations and concepts of science.

Is it not time for some scientific organization, such as the AAAS, to assume this obligation? An active committee of representative and qualified persons could do much to expedite the integration of science into society. A possible name might be "committee on the philosophy and social integration of science." Without some such action, scientific research will continue at its organizational level to flounder and to operate highly inefficiently.

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11 July 1955

More on "Unpublished" Material

The recent attention in *Science* to the problem of citing unpublished material in scientific literature prompts me to applaud.

As an editor in the field of the medical and public health sciences, I would like to add to the accumulation of data on this subject. *Public Health Reports*, official journal of the U.S. Public Health Service, 3 years ago began to insist of its authors that all citations and bibliographic references must be published material.

On occasion, if an author properly qualifies a personal communication to the satisfaction of the editors, he may include it in his text but not in the bibliography. We feel rather strongly that no bibliography should contain material inaccessible to the student and researchers. I find no difficulty in concurring with editor Daniel I. Arnon in his summation [*Science* **121**, 835 (1955)] of the case against the personal communication in reviews.

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Book Reviews

The Hypophyseal Growth Hormone, Nature and Actions. An International Symposium. Richard W. Smith, Oliver H. Gaebler, C. N. H. Long, Eds. Blakiston Div., McGraw-Hill, New York–London, 1955. xv + 576 pp. Illus. $12.

This volume records the proceedings of an international symposium on the nature and action of the adenohypophyseal growth hormone. The splendid success of this volume in communicating the progress made in the basic laboratories and the various clinics on adenohypophyseal growth hormone is the result of myriad contributions made by some 300 scientists from Europe, South America, Canada, and the United States of America. Of paramount significance is the fact that many scientific disciplines, including those of anatomists, physiologists, biochemists, pharmacologists, zoologists, and endocrinologists, were focused on the complexities of the growth hormone problem. I wholeheartedly go on record with the thought that this wide representation of the various fields of the sciences had a great deal to do with the tremendous success of the symposium.

The Hypophyseal Growth Hormone, Nature and Actions records well the progress made in this truly important area of medicine during the past 33 years. In this volume, no tacit assumptions were made. The early work of J. A. Long and H. M. Evans, P. E. Smith and B. Houssay creates a very stable foundation upon which the book develops into growing pillars of information for both the experimentalist and the clinician.

This encyclopedia of information on growth hormone is divided into five sections: "Bioassay, preparation, and physicochemical properties of growth hormone"; "Effects of growth hormone on certain structures"; "Growth hormone and energy sources"; "Growth hormone and cellular systems"; and "Influence of growth hormone on the mammary gland and on human metabolism." Each section is divided into a number of subsections, thus covering the main topic in a most exhaustive manner. The main currents of the scientific method are thoroughly explored *in extenso* throughout all sections of the book. In addition to bringing an individual up to date on growth hormone, the book unfolds a precise view of the evolution of a very exacting scientific problem.

The last chapter, by C. N. H. Long, shows a remarkable synthesis of many of the pertinent remarks made throughout the text. The more perplexing and unsolved aspects of the whole problem of adenohypophyseal growth hormone seem to be the following: (i) the rate of release and utilization of growth hormone throughout life; (ii) the nature of the phenomenon of endocrine control of tissue sensitivity to growth hormone; (iii) a precise detection method for the assay of this hormone in blood; (iv) the duration of the activity of this substance in the body, and (v) the preparation of a growth hormone in indisputably pure form. The lack of the latter strongly indicates that until such a purified preparation becomes available, it will be difficult to develop an assay method with sufficient sensitivity to detect this hormone in body fluids. In the closing remarks, Long summarized the views of Selye and Best. Selye's concept, that somatotropin (growth hormone) causes the release of mineralocorticoids, seems to be getting more confirmation from Beck's statements. Best, of course, still champions the idea that insulin is the excitor of protein anabolism and growth. According to Best, the so-called "growth agent" is isletotropic.

Like most monumental works of science, additional questions are raised and viewed for some very stimulating thought. The wise teachings and experience of Long and E. B. Astwood bring the volume to a most successful finale: "The papers given . . . have emphasized what should never be forgotten, which is that the hormones do not initiate cellular reactions or metabolic transformations. These are intrinsic properties of the cells alone and the hormones merely alter the rate at which certain changes occur. Indeed, in some instances the maximal change in activity produced by a hormone may be only a small fraction of that going on in the unstimulated cell. Nevertheless, these slight displacements, if long continuod, can lead to profound overall changes."

In the final analysis, it can be said that this is a truly outstanding volume; the editors, essayists, discussants, and chairmen will long be remembered for bringing these facts together. The publisher is to be congratulated for the excellence shown in the production of the book. The only significant criticism that could be raised is one dealing with the lack of an index. The editors have compensated in part by supplying a rather good table of contents. The indexing of such a volume would be tremendous. Undoubtedly it would raise the cost of the volume, and it is believed that this factor may well have been responsible for its omission.

I thoroughly enjoyed the book and predict that this wealth of information will be useful in the hands of many communities of scholars where scientists are involved in the elucidation of the complexities associated with our present-day knowledge of growth hormone.

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Protective Coatings for Metals. R. M. Burns and W. W. Bradley. Reinhold, New York, 1955. xiv + 643 pp. Illus. $12.

This book is one of the American Chemical Society Monograph Series (No. 129). The authors are members of the research staff of Bell Telephone Laboratories. The book presents primarily information that will enable those with problems in protection to select the correct type and thickness of coating for a given application and environment. It is, however, much more than a handbook of data, since the topics covered are introduced with clear discussions of basic background information.

The emphasis is mainly on what may be classified as natural corrosive environments, such as the atmosphere, sea water, and soil. More specialized problems, such as coatings for use at high temperatures and on chemical equipment, although they are not entirely neglected, are less fully treated. Methods of production and application of coatings are indicated, but the book does not serve as, and is not intended to be, a manual on this aspect of the field. Adequate references are given on methods for applying coatings.

The scope and content of the book are indicated by the following summary of chapter headings: principles and theory; surface preparation; types of coatings and methods of application; sprayed metal coatings; production, properties, and protective value of the full range of metal coatings, from zinc to the noble and rare metals; test methods for metallic coatings; organic coatings, including chemistry and composition, performance and evaluation, and application and use;

chemical conversion and anodized coatings; special purpose coatings, ranging from slushing compounds to vitreous coatings; and corrosion inhibitors.

This edition has been substantially expanded from that of 1939, with all former chapters brought up-to-date in content and references. The chapters on sprayed coatings and inhibitors are new.

Other available works on corrosion, such as those by Evans, Uhlig, or Speller, contain sections that cover the same area as the present book. However, they treat this area much less fully, with primary emphasis on other aspects of corrosion. The present volume therefore does not duplicate these others but becomes a useful supplement to them.

A few typographic errors and minor errors of fact were noted, but on the whole the level of accuracy is high. The style is readable and explicit, and the quality of the printing and binding is good. The book is recommended to the chemist, corrosion engineer, metallurgist, or anyone concerned with selecting and specifying corrosion protective coatings.

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Biochemistry of the Aminosugars. P. W. Kent and M. W. Whitehouse. Academic Press, New York: Butterworths, London, 1955. ix + 309 pp. $6.80.

The need for a modernized version of Levene's monograph *Hexosamines and Mucoproteins* can hardly be exaggerated. A vast amount of information has accumulated in this very important field, which, up to now, has never been fully summarized and evaluated. The authors of this book deserve credit for having undertaken this difficult task. It is regrettable, however, that the first monograph in this field since Levene's book has not been prepared with greater care and critique.

The book is divided into two main chapters: (i) aminosugars in the biological environment, and (ii) the chemistry of the aminosugars and their derivatives. It seems obvious that the authors are more familiar with the subject of the second as compared with the first chapter. Following are some of the errors and misstatements that were quite obvious from my experience with part of the subject matter.

On page 13 appears the statement that the action of hyaluronidases leads chiefly to disaccharides. This statement is true only for bacterial hyaluronidases. In the scheme on page 13, crude hyaluronidases (containing β-glucuronidase and glucosaminidases) are represented as acting on the disaccharides produced by pneumococcal hyaluronidases. This statement is incorrect. On page 163, the statement is made that hyaluronidases degrade native hyaluronic acid to a disaccharide, hyalobiuronic acid. Hyalobiuronic acid is a deacetylated disaccharide, as is reported correctly on page 108, and even the yield of *N*-acetylhyalobiuronic acid in digests of purified testicular hyaluronidase is very low. On page 106, the statement is made that purified testicular hyaluronidase does not cause further degradation or rearrangement of the primary enzymic products, whereas on page 33, the transglycosidative action of testicular hyaluronidase is correctly reported.

On page 109, "mucosin" is reported to be hydrolyzed by β-glucuronidase, while on page 67, it is correctly quoted from the literature that deaminated mucosin is hydrolyzed by β-glucuronidase. The finding of urinary "mucoprotein" is credited to Gottschalk (1952); its prior isolation by Tamm and Horsfall (1950) is not mentioned. Likewise, the most careful work on the mucoids of human plasma, including the isolation of a crystalline acid mucoid by K. Schmid (1950) is not mentioned.

On page 135, the presence is reported of *N*-acetylglucosamine and galactosamine in type-I pneumococcal polysaccharide. The reference given does not contain any such statement. The same holds true for reference 151 on page 107. On page 189, the formula of altrose is erroneous. The formula on page 212 is not a derivative of dihydropyrazine but of a substituted piperazine. To me, the reproduction of the carbohydrate core of ovomucoid (p. 127) without critical evaluation appears unfortunate. The same applies to many other data reported from the literature. The term *aminodextrins* for oligosaccharide fractions derived from hyaluronic acid, which have very little in common with dextrins, seems unfortunate.

In spite of its shortcomings, the book represents a useful survey of the field, especially since it has no rival to compete with.

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Vitamins in Theory and Practice. Leslie J. Harris. Cambridge Univ. Press, New York–London, ed. 4, 1955. xv + 366 pp. Illus. $6.50.

This book is written in simple language that is easily understandable by and interesting to the lay reader. It is devoted to the discussion of the theoretical and practical aspects of both the water-soluble and oil-soluble vitamins. Thus, for each vitamin, the sources, the symptoms of deficiencies, the chemical structure, and the methods (chemical, microbiological, or animal) for the determination are treated briefly and concisely. The role of various vitamins as coenzymes is described only sketchily and perhaps inadequately for those who might be interested in the fate and mode of action of vitamin, *in vivo*. However, this book contains valuable illustrations and historical background to make it worth while for all students interested in vitamins.

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Johns Hopkins University

Autoradiography in Biology and Medicine. George A. Boyd. Academic, New York, 1954. xiii + 399 pp. Illus. + plates. $8.80.

Becquerel's monumental discovery of the radioactive phenomenon opened new vistas in our understanding of the structure of matter and also provided new tools for probing the distribution of imponderably small quantities of radioactive nuclei in stable systems. The pattern of the distribution, outlined on a photographic plate by the energetic radiations emitted in the decay of the radioactive material, termed an *autoradiograph*, found many fields of useful application. However, even 40 years after the basic discovery, a survey of the biological literature would scarcely yield sufficient information for the assembly of a modestly sized review essay. This minor application of autoradiography in the medical field is largely attributable to the nature of the radioactive species, available as tracers during that period. The spontaneous disintegration of uranium and thorium provided the investigator with heavy metal tracers such as radium and polonium, which although of toxicological interest, could not be employed to study the migratory course of the lighter elements that play a predominant role in biochemical systems.

Since the discovery of the neutron and the synthesis of radioactive isotopes representative of virtually the entire periodic system of elements, the application of tracer techniques in biology and medicine has been increasing at a seemingly exponential pace. Today this phase of the literature greatly exceeds all other applications of autoradiography in the combined fields of metallurgy, crystallography, and mineralogy, once the principal source of the experimental techniques. Investigators studying the localization of radioactive isotopes in biologi-

cal systems will therefore find in Boyd's volume on the subject a useful compendium on the properties of photographic emulsions, dealing with both their virtues and their ailments, and a detailed description of histological and photographic techniques best adapted to the study of diverse types of biological tissues. This section of Boyd's book should prove invaluable to investigators approaching the subject with a feeling of timidity and will prove a *vade mecum* to the experienced darkroom adept.

The book contains a comprehensive bibliography of the biological and medical literature containing descriptions of autoradiographic techniques. This section is rendered particularly useful by means of supplementary analytic indexes, which classify the several hundred publications according to the identity of the radioactive isotope employed and the nature of the tissue and animal studied. The book is well printed and handsomely illustrated with numerous autoradiographs.

HERMAN YAGODA
Laboratory of Physical Biology, National Institutes of Health

Organic Solvents: Physical Properties and Methods of Purification. vol. VII of *Technique of Organic Chemistry*. Arnold Weissberger, Ed. Interscience, New York–London, ed. 2, 1955. vii + 522 pp. $8.50.

The appearance of the revised and second edition of the book on organic solvents is, indeed, a welcome addition to the reference literature of organic chemistry. The first edition, although ably compiled and presented, has long been out of date, and this second edition increases the usefulness of the reference material. The collaboration of an organic and a physical chemist in the presentation of the material on organic solvents greatly enhances the usefulness of the volume.

Following a simple classification according to organic chemical principles of the compounds indicated as solvents, the authors present a discussion of the properties and criteria of the physical properties and purity of the solvents in question. An adequate discussion is given of the boiling point, vapor pressure, density, refractive index, viscosity, surface tension, heat of vaporization, critical temperature and pressure, freezing-point constant, electric properties, flash point, and spectroscopy as well as the toxicology of the solvents. There then follow the complete data on 254 organic compounds utilizable as solvents under various conditions. Following this, there are tables arranged according to boiling point, freezing point, dielectric constant, and dipole moment. A useful series of indexes based on increasing boiling points, freezing points, dielectric constants, and dipole moments are included. This type of cross reference will be of considerable help to the researcher.

There next follows a chapter on the criteria of purity of solvent and the drying and determination of water. This will be especially useful for the practicing organic and physical chemists as well as those engaged in industrial work. The chapter containing the methods of purification for the compounds described is again a reasonably complete compilation of the literature. Although no completely critical evaluation of methods for purification have been attempted, there being several references to each compound, there is sufficient information given so that the researcher can consult the original literature. Of equal importance with the data presented in the book is the complete bibliography at the end and before the index. The whole worth of the book may be summarized in the words of the original author, "the aim of this book is to make readily accessible the abundant material which has been accumulated by chemists and physicists in recent years."

CARLETON W. ROBERTS
Department of Chemistry, Purdue University

Fluoridation as a Public Health Measure. American Assoc. for the Advancement of Science, J. H. Shaw, Ed., Washington, D.C., 1954. v + 232 pp. Illus. $4.50; AAAS members, $4.

This monograph is opportune and timely. Many of the questions raised by certain opponents of fluoridation have been ably answered with incontrovertible evidence. Twenty-one different scientists from the fields of chemistry, dentistry, engineering, and medicine have collaborated in this effort.

Two chapters—one a 10-year study of the medical aspects of an excessive fluoride intake from a water supply, the other a long-term medical study of a population using a fluoridated water supply—provide valuable information on the frequently posed question of complete medical studies. In other chapters, such subjects as the metabolism of inorganic fluorides, the magnitude of the dental benefits, the public health aspects of water fluoridation, the relative merits of various fluoridation vehicles, and the engineering and water chemistry phases of fluoridation are capably discussed by workers with years of experience in their respective fields. One chapter is devoted to the external action of fluorides on teeth, the so-called "topical application," of much interest to that portion of the population not using a public water supply.

The book has been carefully edited, and these diverse subjects have been blended into a coherent whole. It is written in an easily readable style of interest to scientists, public health workers, civic officials, and interested laity alike. A second printing would seem to be assured.

In the closing words of the preface, the editor states ". . . through the providence of nature, no other public health procedure in the annals of history has been so thoroughly tested in field trials under the widest variety of controlled circumstances." This monograph ably summarizes this evidence.

H. TRENDLEY DEAN
American Dental Association

Manganese. Metallurgy of the rarer metals, No. 3. A. H. Sully, Academic, New York; Butterworths, London, 1955. xiv + 305 pp. Illus. $6.50.

This book, the third in a series, is a summary of the literature on one of the so-called "rarer metals," manganese. Personnel engaged in research or plant operation will find it a well-written and comprehensive reference book.

The book opens with a description of the history of manganese and the worldwide occurrence and distribution of its ores. Following this, the metallurgical processes for obtaining manganese from its ores are discussed. Included are the blast and electric furnace processes for preparing high- and low-carbon ferromanganese and also the electrolytic process for the commercial production of high-purity, 99.3 percent, manganese. Methods for the recovery of manganese from furnace slags and low-grade ores are described.

Research workers will find the chapter pertaining to the physical properties of manganese of much use. The section on the four allotropic modifications of this metal contains data on the crystal structure, lattice constants, and transition temperatures. The published data on melting point, vapor pressure, specific heat, thermal expansion, electric resistivity, magnetic and other properties of manganese have been compiled and reviewed.

For many years manganese has been used extensively as a minor alloying element in ferrous and nonferrous materials. The commercial production of high-purity manganese has extended its use

as a major alloying constituent. In accordance with these applications, about one-third of the book is devoted to a summary of the literature on the constitution and properties of the binary and ternary alloys of manganese.

The final chapter of the book contains a brief discussion of the limited workability of manganese. Included also are descriptions of the methods for electroplating and vapor-phase impregnation of materials with manganese and the oxidation characteristics of this element at high temperatures.

In view of the rapidly increasing list of publications in the metallurgical literature, one finds it very helpful to obtain such excellent compendia on specific subjects.

EARL S. GREINER
Bell Telephone Laboratories

New Books

Nuclear and Radiochemistry. Rev. version of *Introduction to Radiochemistry.* Gerhart Friedlander and Joseph W. Kennedy. Wiley, New York; Chapman & Hall, London, 1955. 468 pp. $7.50.

Haplorhini: Tarsioidea. vol. II of *Primates: Comparative Anatomy and Taxonomy.* W. C. Osman Hill. Interscience, New York; University Press, Edinburgh, 1955. 347 pp. $9.50.

The Origin of Vertebrates. N. J. Berrill. Clarendon Press, Oxford, 1955. 257 pp. $4.

Chemistry of the Solid State. W. E. Garner, Ed. Academic Press, New York; Butterworths, London, 1955. 417 pp. $8.80.

Vector and Tensor Analysis. Nathaniel Coburn. Macmillan, New York, 1955. 341 pp.

Magic and Schizophrenia. Géza Róheim. Warner Muensterberger, Ed. International Universities Press, New York, 1955. 230 pp. $4.50.

Biochemical Preparations. vol. 4. W. W. Westerfeld, Ed. Wiley, New York; Chapman & Hall, London, 1955. 108 pp. $3.75.

Energy and Society. The relation between energy, social change, and economic development. Fred Cottrell. McGraw-Hill, New York, 1955. 330 pp. $6.

Tungsten. Its history, geology, ore-dressing, metallurgy, chemistry, analysis, applications, and economics. American Chemical Soc. Monogr. No. 94. K. C. Li and Chung Yu Wang. Reinhold, New York; Chapman & Hall, London, ed. 3, 1955. 506 pp. $14.

Non-Euclidean Geometry. A critical and historical study of its developments. Roberto Bonolo. Trans. by H. S. Carslaw. Dover, New York, 1955. 389 pp. Cloth, $3.95; paper, $1.90.

Human Physiology. F. R. Winton and L. E. Bayliss. Little, Brown, Boston, ed. 4, 1955. 616 pp. $8.

The Negro in Science. Julius H. Taylor, Ed. Morgan State College Press, Baltimore, Md., 1955. 192 pp. $3.50.

Monographs on Topics of Modern Mathematics Relevant to the Elementary Field. J. W. A. Young, Ed.; with a new introduction by Morris Kline. Dover, New York, 1955. 416 pp. Cloth, $3.95; paper, $1.90.

Diffusion and Heat Exchange in Chemical Kinetics. D. A. Frank-Kamenetskii. Trans. by N. Thon. Princeton Univ. Press, Princeton, N.J., 1955. 370 pp. $6.

Magnetic Materials in the Electrical Industry. P. R. Bardell. Philosophical Library, New York, 1955. 288 pp. $10.

Contributions to Plant Anatomy. vol. 15. Irving W. Bailey. Chronica Botanica, Waltham, Mass.; Stechert-Hafner, New York, 1954. 262 pp. $7.50.

Directory of Scientific Research Organizations in the Union of South Africa. D. Ryle Masson, Ed. Van Schaik, Pretoria, 1955. 123 pp. 25s.

Embryologie. Ein Lehrbuch auf Allgemein Biologischer Grundlage. Dietrich Starck. Thieme, Stuttgart, Germany, 1955. 688 pp. $18.55.

Introductory Nuclear Physics. David Halliday. Wiley, New York; Chapman & Hall, London, ed. 2, 1955. 493 pp. $7.50.

Hydrodynamics. A study in logic, fact and similitude. Garrett Birkhoff. Dover, New York, 1955. 186 pp. Cloth, $3.50; paper, $1.75.

Physics and Microphysics. Louis De Broglie. Trans. by Martin Davidson; foreword by A. Einstein. Pantheon, New York, 1955. 286 pp. $4.50.

Theory of Groups of Finite Order. W. Burnside. Dover, New York, ed. 2, 1955. 512 pp. Cloth, $3.95; paper, $2.

Seven Men among the Penguins. An Antarctic venture. Mario Marrett. Trans. from the French by Edward Fitzgerald. Harcourt, Brace, New York, 1955. 269 pp. $4.50.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

AEC–FCDA Relationship. Hearing before the subcommittee on security, Joint Committee on Atomic Energy, Congress of the United States, Eighty-fourth Congress, first session. The Committee, Washington, D.C., 1955. 57 pp.

Statistics of Public Elementary and Secondary Education of Negroes in the Southern States: 1951–52. Circ. No. 444. Carol Joy Hobson. U.S. Office of Education, Washington, D.C., 1955. 18 pp.

Salaries and Other Characteristics of Beginning Rural School Teachers: 1953–54. Brief report of a pilot survey. Circ. No. 446. Wells Harrington and Mabel C. Rice. U.S. Office of Education, Washington, D.C., 1955. 16 pp.

Man in Cold Environment. A study in physiology. Loren D. Carlson. Arctic Aeromedical Laboratory, Ladd Air Force Base, Fairbanks, 1954. 161 pp. (Available from U.S. Dept. of Commerce, Officé of Technical Services, Washington, D.C.)

Georgia Mineral Newsletter. vol. VIII, No. 2. Georgia Geological Survey, Atlanta, 1955. 84 pp.

Organization and Administration of the Military Research and Development Programs. Hearings before a subcommittee of the Committee on Government Operations, House of Representatives, Eighty-third Congress, second session. The Committee, Washington, D.C., 1954. 710 pp.

Proceedings. Thirteenth session, South Pacific Commission, Noumea, 11–28 Oct. 1954. The Commission, Noumea, 1955. 31 pp.

Methods for Determining Lead in Air and in Biological Materials. American Public Health Assoc., New York, 1955. 69 pp. $1.25.

Ninth Annual Report, 1953–1954. South African Council for Scientific and Industrial Research. Pretoria, 1955. 142 pp.

Studies on Expenditure of Energy and Consumption of Food by Miners and Clerks, Fife, Scotland, 1952. Medical Research Council Special Rept. Ser. No. 289. R. C. Garry, R. Passmore, Grace M. Warnock, J. V. G. A. Durnin. Her Majesty's Stationery Office, London, 1955. 5s.

Psychological Tests for Accident Proneness and Industrial Proficiency. Medical Research Council Memorandum No. 31. E. G. Chambers. Her Majesty's Stationery Off., London, 1955. 2s.

Report to the Board of Governors by the Scientific Director, January 1, 1954–December 31, 1954. National Vitamin Foundation, New York, 1955. 85 pp.

Sown Pastures for South-Eastern Queensland. Bull. No. 274. T. B. Paltridge. Commonwealth Scientific and Industrial Research Organization, Melbourne, 1955. 108 pp.

Proceedings Volume of the Geological Society of America for 1954. The Society, Baltimore, Md., 1955. 204 pp.

Mechanics of Bottom Sediment Movement Due to Wave Action. Tech. Memorandum No. 75. Beach Erosion Bd., Corps of Engineers, 1955. 121 pp.

Movement of Sand around Southern California Promontories. Tech. Memorandum No. 76. Beach Erosion Bd., Corps of Engineers, 1955. 60 pp.

Water Surface Roughness and Wind Shear Stress in a Laboratory Wind-Wave Channel. Tech. Memorandum No. 74. Beach Erosion Bd., Corps of Engineers, 1955. 42 pp.

Ricerca Scientifica e Produzione del Medicamento in Italia. Atti del I° Convegno della Società Italiana Scienze Farmaceutiche, Rome, 29–30 Oct. 1954, Istituto di Chimica Farmaceutica, Città Universitaria. 176 pp.

Schoolroom Science Center. vol. 49, No. 1, Cornell Rural School Leaflet. New York State College of Agriculture, Cornell Univ., Ithaca, 1955. 63 pp.

Le Phytoplancton Etat Actuel de nos Connaissances sur les Grands Lacs Est-Africains et Leur Phytoplancton. Ludo Van Meel. A, Texte; B, Atlas. vol. IV, fasc. 1. Exploration Hydrobiologique du Lac Tanganika, 1946–1947. Institut Royal des Sciences Naturelles de Belgique, Bruxelles, 1954. 679 pp.

Type-of-Farming Areas in Arkansas. V. B. Fielder. Bull. 555. Agricultural Expt. Sta., Univ. of Arkansas, Fayetteville, 1955. 121 pp.

Scientific Meetings

Physics and Engineering

The summer meeting of the American Association of Physics Teachers was held at Pennsylvania State University, University Park, 21–23 June. The American Society for Engineering Education met concurrently but for a longer period of time.

The first two mornings were devoted to short papers that were concerned chiefly with specific problems of demonstration or presentation, of which only a few will be mentioned here. The opening paper by Mark Zemansky (City College of New York) was a beautiful demonstration of colored patterns obtained with convergent polarized light, using uniaxial and biaxial crystals and one crystal that changed from biaxial to uniaxial with rise in temperature. H. Medicus and F. Bitter (Massachusetts Institute of Technology) described various demonstrations in which the shadow projection technique was valuable in that it gave enlarged images of the phenomena under observation.

An unscheduled paper on "Industry's stakes in the teaching of engineering" by Alton P. Wangsgard (Hughes Aircraft Corporation) noted industry's difficulty in obtaining competent physicists and its willingness to assist in the solution of this problem by hiring professors on sabbatical leave and by setting up cooperative fellowships whereby a student, while enjoying industry's benefits, could get a master's degree in 3 years. Rosalie Hoyt (Bryn Mawr) showed experiments in sound interference with an electrostatic speaker as the source instead of the Galton whistle used by Schilling.

Four half-day sessions were devoted to joint meetings with the physics section of the ASEE on the teaching of physics in engineering colleges. For the most part, in these sessions there was a sense of cooperation between the physics professor and the engineering professor, a sense that their work is not competitive but complementary, and that the student will gain more if the physicist teaches physics, stressing the fundamental principles, and the engineer teaches engineering, emphasizing the appropriate applications of these underlying principles.

The invited speakers at these sessions were equally chosen from the two fields. They tended to stress the point that improved communication between physicists and engineers at the institutional level to discuss objectives and to determine mutual needs would do much to alleviate apparent differences of opinion and would produce a sympathetic view of the other's objectives. It was urged in a report of a committee of the American Institute of Physics, entitled "The role of physics in engineering education" (preprint of 15 June 1955, p. 13) that "members of the departments of physics and engineering should meet frequently together for free discussion in order that they may come to understand and appreciate more clearly their common interests and mutual needs."

W. V. Houston (Rice Institute) spoke at a joint dinner of the AAPT and the physics section of the ASEE and also at an informal luncheon. He stressed that a liberal education involves both the humanities and the sciences and that physics contributes to the humanities side of an engineer's education.

MILDRED ALLEN
Mount Holyoke College,
South Hadley, Massachusetts

Meeting Notes

■ Evaluation of practical experience with the Salk poliomyelitis vaccine by key figures in its development will be a feature of the 83rd annual meeting of the American Public Health Association and meetings of 40 related organizations in the Kansas City, Mo., Municipal Auditorium, 14–18 Nov. Participants in a panel discussion on poliomyelitis will include Jonas E. Salk of the University of Pittsburgh, who developed the vaccine; Thomas Francis, Jr., of the University of Michigan, who directed evaluation of field tests that led to its adoption; Leonard A. Scheele, Surgeon General of the U.S. Public Health Service; Hart E. Van Riper, medical director of the National Foundation for Infantile Paralysis; and Robert E. DeFries of the University of Toronto. The moderator will be Malcolm E. Merrill, director of public health, Berkeley, Calif.

Herman E. Hilleboe, New York State Commissioner of Health and president of the APHA, will preside at the special session on poliomyelitis, one of 75 scientific sessions scheduled. More than 5000 professional public health practitioners from governmental agencies and private health organizations, both here and abroad, are expected to attend, according to Reginald M. Atwater, executive secretary of the association. The over-all theme of the meeting is "Where are we going in public health?"

In all, more than 400 scientific papers will be presented on topics ranging from prevention of home accidents to combating cancer, tuberculosis, smog, and radioactive fallout. Among topics to be emphasized are mental health, neighborhood planning, new approaches to chronic diseases, and experience with various medical care plans.

■ This year's meeting of the German Societies for the Sciences of Fats will take place in Münster, Westphalia, 25–30 Sept. From 30 Sept. to 3 Oct., the same societies will organize a course on modern methods of research on fats and fat products.

■ Announcement of the completed program for the 29th annual fall meeting of the American Oil Chemists' Society, which is to be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., 10–12 Oct. is made in the September issue of the *Journal of the American Oil Chemists' Society*. The program chairman is W. C. Ault of the Eastern Regional Research Laboratory, Philadelphia.

A total of 56 technical papers will be presented at general, concurrent, or student sessions. Special topics will include detergents, analytic techniques, chemical modification, shortenings, nutrition, oxidation, and polymerization, as well as general research.

Forthcoming Events

October

16. American College of Dentists, San Francisco, Calif. (O. W. Brandhorst, 4221 Lindell Blvd., St. Louis, Mo.)

16–19. Soc. of American Foresters, Portland, Ore. (H. Clepper, 425 Mills Bldg., Washington 6.)

17–19. Detroit Institute of Cancer Research, 8th annual, Detroit, Mich. (Wm. L. Simpson, 4811 John R St., Detroit 1.)

17–20. American Dental Assoc., annual, San Francisco, Calif. (H. Hillenbrand, 222 E. Superior St., Chicago 11.)

17–21. National Metal Exposition and Cong., Philadelphia, Pa. (C. L. Wells, 7301 Euclid Ave., Cleveland 3, Ohio.)

18. American Soc. of Safety Engineers, annual, Chicago, Ill. (J. B. Johnson, 425 N. Michigan Ave., Chicago 11.)

18. Oak Ridge Inst. of Nuclear Studies,

council meeting, Oak Ridge,Tenn. (W. G. Pollard, P. O. Box 117, Oak Ridge.)

18–19. National Acad. of Economics and Political Science, Washington, D.C. (D. P. Ray, Hall of Government, George Washington Univ., Washington 6.)

18–20. Entomological Soc. of Canada and the Acadian Entomological Soc., annual joint meeting, Fredericton, New Brunswick. (R. H. Wigmore, Science Service Bldg., Ottawa, Canada.)

18–21. American Dietetic Assoc., annual, St. Louis, Mo. (R. M. Yakel, ADA, 620 N. Michigan Ave., Chicago 11, Ill.)

19–21. International Conf. on the Use of Antibiotics in Agriculture, Washington, D.C. (H. I. Cole, National Research Council, Div. of Biology and Agriculture, 2101 Constitution Ave., Washington 25, D.C.)

19–21. Symposium on Applications of Radioactivity in Food and Food Processing Industries, Boston, Mass. (W. A. Stenzel, Tracerlab Inc., 130 High St., Boston 10.)

20–21. National Noise Abatement Symposium, 6th annual, Chicago, Ill. (R. W. Benson, Armour Research Foundation, Illinois Inst. of Technology, Chicago.)

22. American Mathematical Soc., College Park, Md. (AMS, 80 Waterman St., Providence 6, R.I.)

22–24. American Heart Assoc., 28th annual scientific session, New Orleans, La. (Medical Director, AHA, 44 E. 23 St., New York 10.)

24. American Ethnological Soc., New York, N.Y. (Miss A. G. James, 695 Park Ave., New York 21.)

24–26. National Conf. on Standards, 6th, Washington, D.C. (G. P. Paine, ASA, 70 E. 45 St., New York 17.)

24–28. American Soc. of Civil Engineers, New York, N.Y. (W. N. Carey, ASCE, 33 W. 39 St., New York 18.)

24–1. International Council for the Exploration of the Sea, annual, Copenhagen, Denmark. (General Secretary of Council, Charlottenlund Castle, Charlottenlund, Denmark.)

25–30. American Ornithologists' Union, Boston, Mass. (H. F. Mayfield, 2557 Portsmouth Ave., Toledo 13, Ohio.)

27–28. New Mexico Acad. of Science, Albuquerque. (C. C. Hoff, Dept. of Biology, Univ. of New Mexico, Albuquerque.)

27–29. American Ceramic Soc., 8th Pacific Coast Regional, Seattle, Wash. (C. S. Pearce, 4055 N. High St., Columbus 14, Ohio.)

27–29. Conf. on Rare Earths in Biochemical and Medical Research, Oak Ridge, Tenn. (G. C. Kyker, Oak Ridge Inst. of Nuclear Studies, P.O. Box 117, Oak Ridge.

27–29. Electron Microscope Soc. of America, University Park, Pa. (Miss J. R. Cooper, General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio.)

27–29. Gerontological Soc., Baltimore, Md. (N. W. Shock, Baltimore City Hospitals, Baltimore 24.)

27–29. Pharmaceutical Industry: Rensselaer Polytechnic Inst. Industrial Council, 5th annual, Troy, N.Y. (F. Tifft, News Bureau, Rensselaer Polytechnic Inst., Troy.)

28–30. American Soc. for Aesthetics, Chicago, Ill. (J. F. White, Western Reserve Univ., Cleveland 6, Ohio.)

30–1. West Virginia Science Fair Work Conf., Weston. (D. E. Large, Science Fair Program, P.O. Box 117, Oak Ridge, Tenn.)

31–1. East Coast Conf. on Aeronautical and Navigational Electronics of Inst. of Radio Engineers, Baltimore, Md. (G. R. White, Bendix Radio Div., Bendix Aviation Corp., Towson 4, Md.)

31–5. Conf. on Solar Energy, Scientific Basis, Tucson, Ariz. (31–1 Oct.); World Symposium on Applied Solar Energy, Phoenix, Ariz. (1–5 Nov.). (M. L. Kastens, Stanford Research Inst., Stanford, Calif.)

November

1–3. Enzymes: Units of Biological Structure and Function, International Symposium, Detroit, Mich. (C. E. Rupe, Henry Ford Hospital, Detroit 2.)

2–4. American Documentation Inst., annual, Philadelphia, Pa. (S. Rosenborg, Library of Congress, Washington 25.)

2–4. Society of Rheology, annual, New York. (W. R. Willets, Titanium Pigment Corp., 99 Hudson St., New York 13.)

2–4. Symposium on Antibiotics, 3rd annual, Washington, D.C. (H. Welch, Div. of Antibiotics, Food and Drug Admin., U.S. Dept. of Health, Education, and Welfare, Washington 25.)

2–5. American Soc. of Tropical Medicine and Hygiene, Boston, Mass. (J. E. Larsh, Jr., School of Public Health, Univ. of North Carolina, Chapel Hill.)

3. American Federation for Clinical Research, Midwestern, Chicago, Ill. (R. J. Glaser, Barnes Hospital, 600 S. Kingshighway, St. Louis 10, Mo.)

4–5. American College of Anesthesiologists, Boston, Mass. (S. C. Hershey, 235 E. 22 St., New York 10.)

4–5. Kentucky Academy of Science, Frankfort, Ky. (Mary E. Wharton, Georgetown College, Georgetown, Ky.)

5. Committee for the Scientific Study of Religion, Cambridge, Mass. (R. V. McCann, Andover Hall, Harvard Univ., Cambridge 38.)

6–7. American Soc. for the Study of Arteriosclerosis, 9th annual, Chicago, Ill. (O. J. Pollak, P.O. Box 228, Dover, Del.)

6–13. International Cong. of Allergology, Rio de Janeiro, Brazil. (F. Alves, Avenida Rio Branco 277, 7° andar, Rio de Janeiro.)

7–9. Assoc. of Military Surgeons of the United States 62nd annual, Washington, D.C. (AMSUS, 1726 Eye St., NW, Washington 6.)

7–9. Eastern Joint Computer Conf., AIEE, IRE, ACM, Boston, Mass. (I. Travis, Burroughs Res. Center, Paoli, Pa.)

7–9. Geological Soc. of America, annual, New Orleans, La. (H. R. Aldrich, 419 W. 117 St., New York 27.)

7–9. Mineralogical Soc. of America, New Orleans, La. (C. S. Hurlbut, Jr., 12 Geological Museum, Oxford St., Cambridge 38, Mass.)

7–9. Paleontological Soc., New Orleans, La. (K. E. Caster, Dept. of Geology, Univ. of Cincinnati, Cincinnati 21, Ohio.)

7–9. Soc. of Economic Geologists, New Orleans, La. (O. N. Rove, Union Carbide and Carbon Corp., 30 E. 42 St., New York 17.)

8. Assoc. of Geology Teachers, New Orleans, La. (R. L. Bates, Dept. of Geology, Ohio State Univ., Columbus 10.)

9–12. American Council of Independent Laboratories, Phoenix, Ariz. (H. M. Dudley, 4302 East-West Highway, Washington 14.)

9–13. International Symposium on Tuberculosis in Infancy and Childhood, Denver, Colo. (L. S. Smith, National Jewish Hospital, Denver 6.)

10. Assoc. of Vitamin Chemists, Chicago, Ill. (M. Freed, 4800 S. Richmond, Chicago 32.)

10–11. American Philosophical Soc., Philadelphia, Pa. (L. P. Eisenhart, 104 S. 5 St., Philadelphia 6.)

10–12. American Astronomical Soc., Troy, N.Y. (J. A. Hynek, McMillin Observatory, Ohio State Univ., Columbus 10.)

10–12. American College of Cardiology, 4th, Memphis, Tenn. (P. Reichert, American College of Cardiology, Empire State Bldg., New York 1.)

11–12. Inter-Society Cytology Council, 3rd annual, Cleveland, Ohio. (P. F. Fletcher, 634 N. Grand Ave., St. Louis 3, Mo.)

13–18. American Soc. of Mechanical Engineers, 75th annual, Chicago, Ill. (C. E. Davies, 29 W. 39 St., New York 18.)

14–16. Technical Conf. on Electrical Techniques in Medicine and Biology, 8th annual, Washington, D.C. (T. Rogers, Machlett Laboratories, 1063 Hope St., Springdale, Conn.)

14–17. International Automation Exposition, 2nd, Chicago, Ill. (R. Rimbach Associates, 845 Ridge Ave., Pittsburgh 12, Pa.)

14–18. American Public Health Assoc., Kansas City, Mo. (R. M. Atwater, APHA, 1790 Broadway, New York 19.)

14–18. New England Inst. for Hospital Administrators, 7th, Boston, Mass. (D. Conley, ACHA, 620 N. Michigan Ave., Chicago 11, Ill.)

15–17. American Meteorological Soc., Honolulu, Hawaii. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

15–17. Geophysical Soc. of Hawaii, Honolulu. (L. Eber, Pineapple Research Inst., Honolulu.)

16–18. Soc. for Experimental Stress Analysis, Chicago, Ill. (W. M. Murray, SESA, Box 168, Cambridge 39, Mass.)

17–19. American Anthropological Assoc., Boston, Mass. (W. S. Godfrey, Jr., Logan Museum, Beloit College, Beloit, Wis.)

18–19. American Mathematical Soc., Knoxville, Tenn. (E. G. Begle, Yale Univ., New Haven 11, Conn.)

18–19. North Carolina Science Fair Work Conf., Greensboro. (D. E. Large, Science Fair Program, P.O. Box 117, Oak Ridge, Tenn.)

22–23. National Council of Geography Teachers, Indianapolis, Ind. (I. C. Robertson, State Teachers College, Valley City, N.D.)

22–25. International Cong. on Documentation of Applied Chemistry, 1st, Lon-

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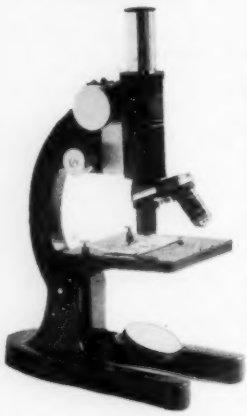

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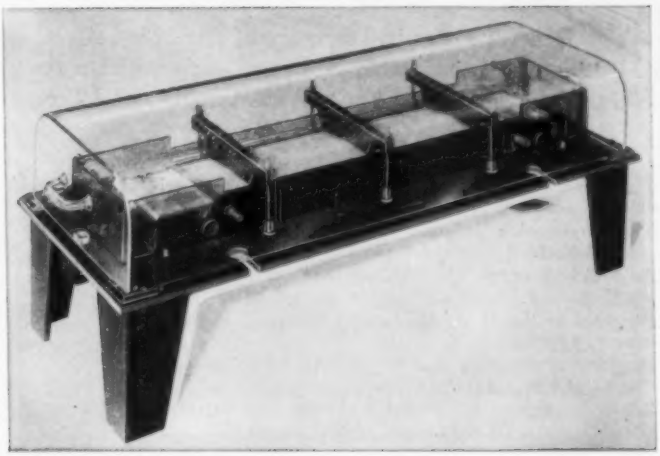

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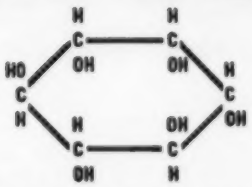

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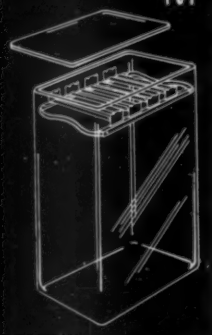

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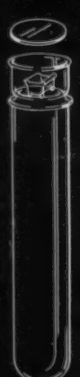

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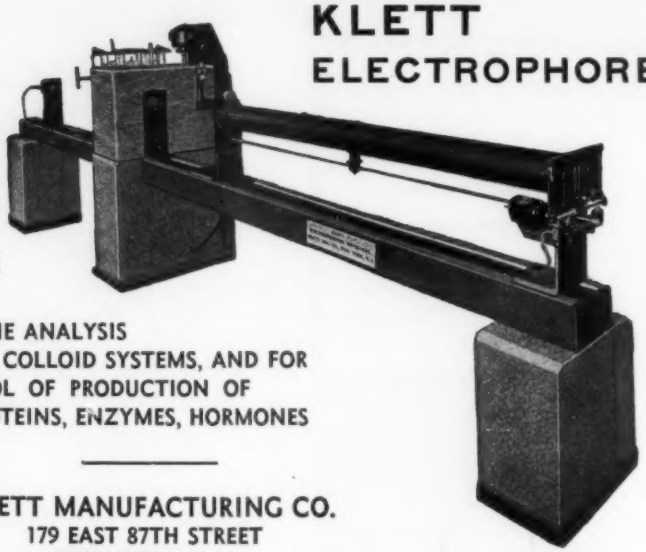

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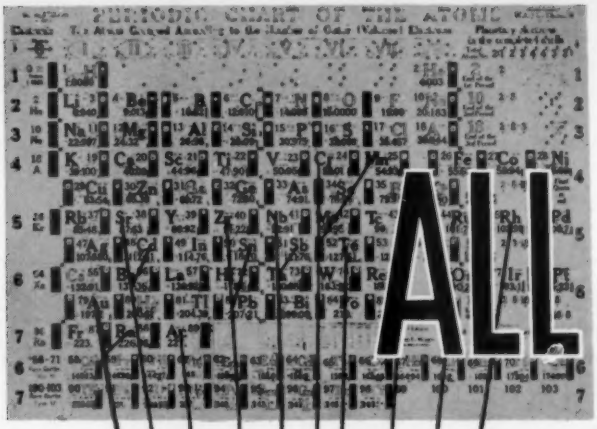

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